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Goddard Space Flight Center
Greenbelt, MD

NPP SDS VIIRS Land PEATE System Design Document

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Version 1.1

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1. Reference Material

[1] SDS Concept of Operations, GSFC 429-05-11-02, June 2005
[2] SDS Systems Requirements Specification, GSFC 429-05-11-01, June 2005
[3] Land PEATE VIIRS Science Data Processing System Description V1.1, NPP_002 Rev A, September 19, 2006

2. VIIRS Land Product Evaluation and Analysis Tool Element (PEATE)

The NPP Visible Infrared Imager Radiometer Suite (VIIRS) Land PEATE will function as described in Ref.: [1] SDS Concept of Operations. The PEATE's characteristics are captured as a set of requirements in Ref.: [2] SDS System Requirements Document. The PEATE will provide functions for the NASA VIIRS Land Science Team (ST) and the NPP Instrument Calibration and Support Element (NICSE) in support of their goal to validate VIIRS Sensor Data Record (SDR) and Land Environmental Data Record (EDR) performance and to assess the suitability of operational EDRs for use in climate analysis. The PEATE will also provide functions for developing improvements to the operational algorithms which generate SDR and EDR products in the Interface Data Processing Segment (IDPS). In summary, the PEATE will be a system that will assist the ST and the NICSE in the following activities:

- analyze operational xDRs (any of RDR[Raw Data Record], SDR and/or EDR)
- analyze pre- and post-launch VIIRS calibration
- analyze operational IDPS algorithm software
- devise xDR algorithm improvements
- test and demonstrate improvements
- share findings with the community

This System Design Document describes the Land PEATE processes that will be utilized in the Launch-6 (L-6) month timeframe. Section 2.1 (Logical Design) describes the various functions of the Land PEATE as they will be for this L-6 months system. Planned implementation of these functions is discussed in Section 2.2 (Implementation) and Operational Examples of PEATE activities are given in Section 2.3 for the present day system and for the L-6 months system. The Gap Analysis bridging the present system to the L-6 month system is given in Section 2.4 together with the Deployment System given in Section 2.5

2.1 Logical Design

This section describes the Land VIIRS PEATE functionality that will be available to support the ST and the NICSE in evaluating the xDRs and in deriving improved versions of the operational science algorithms.

2.1.1 Overview

In support of the ST and NICSE activities, the PEATE will:

- Ingest, store, and organize emerging versions of VIIRS data and software.
- Provide an environment in which SDRs and EDRs can be assessed and software can be altered and tested in different configurations.
- Provide a system where the modified algorithms can be executed against large amounts of VIIRS and non-VIIRS science data so as to determine long-term impact of any potential software changes.
- Provide a number of different access methods to the data, documentation, and software.
- Provide a discussion forum where interesting artifacts can be posted along with descriptions and pictures so that a community discussion can be carried on, and where status of any related efforts can be shown and tracked.

Figure 2.1.1 is a simple state diagram illustrating use of the Land PEATE.

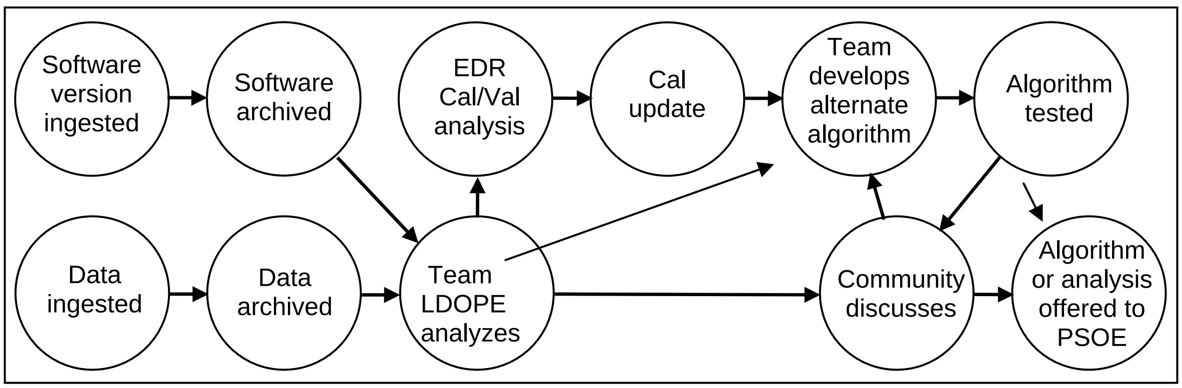

Figure 2.1.1 Land PEATE State Diagram

As shown in Figure 2.1.1, the PEATE will ingest software or data and will store/archive it. The ST and NICSE will analyze the software and data. Analysis results will be provided for the community to discuss. Outcome of the discussions might lead to algorithm improvements that will then be implemented and tested. The community will scrutinize test results. When the ST/NICSE is satisfied that an updated algorithm generates improved products, related analyses and/or the improved algorithm will be offered to the Project Science Office Element (PSOE) for potential assimilation into the operational NOAA system.

During Calibration/Validation (Cal/Val), the NICSE, supported by the PEATE, will perform Cal/Val-specific analysis that might result in calibration table updates or algorithm changes. The table or algorithm changes would be tested and results will be provided for the community to discuss. Cal/Val-related results will be, likewise, offered to the PSOE.

Figure 2.1.2 illustrates the relationship between the various PEATE components. The following sections of this document within the Logical Design and Implementation sections are grouped by these components. At the top is the Science Analysis Facility that provides the principal interface to the ST and the NICSE. This component includes the receipt of requests for products from the ST/NICSE, the distribution of the resulting products to the ST/NICSE, and the Land PEATE xDR product evaluations performed in support of the ST/NICSE. This component will be most capable in steering the rest of the system's activities, but it will be least capable in terms of data storage capacity and data processing power. The Science Analysis Facility will draw on resources below it.

The Engineering Support System in the middle of Figure 2.1.2 provides the internal Land PEATE infrastructure support for meeting the requirements of the ST and the NICSE. This component includes support of efficient software development, tools for integrating algorithm modifications into the Evaluation Processing System, and Land PEATE algorithm testing. This component has an intermediate capacity to store test data and run limited data processing.

The Evaluation Processing System, at the bottom of the pyramid, will be most capable in storing and managing large amounts of data. It will also have sufficient power to process data. The Evaluation Processing System will also have the least capability to perform analysis and visualization of tests, but it will be capable of running complex analysis software and generating and storing the data products required by the ST and the NICSE.

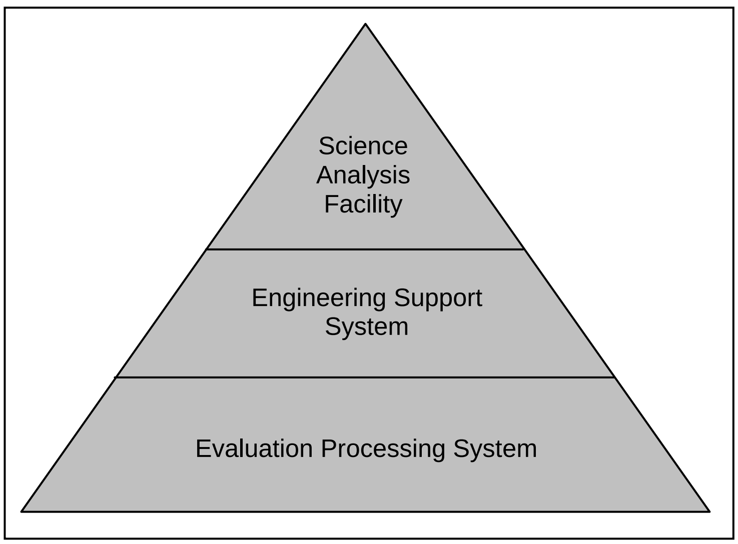

Figure 2.1.2 Land PEATE Facility Hierarchy

2.1.2 External Interfaces

The Land PEATE will have a number of interfaces to external elements as shown in Figure 2.1.3. An overview of each interface follows.

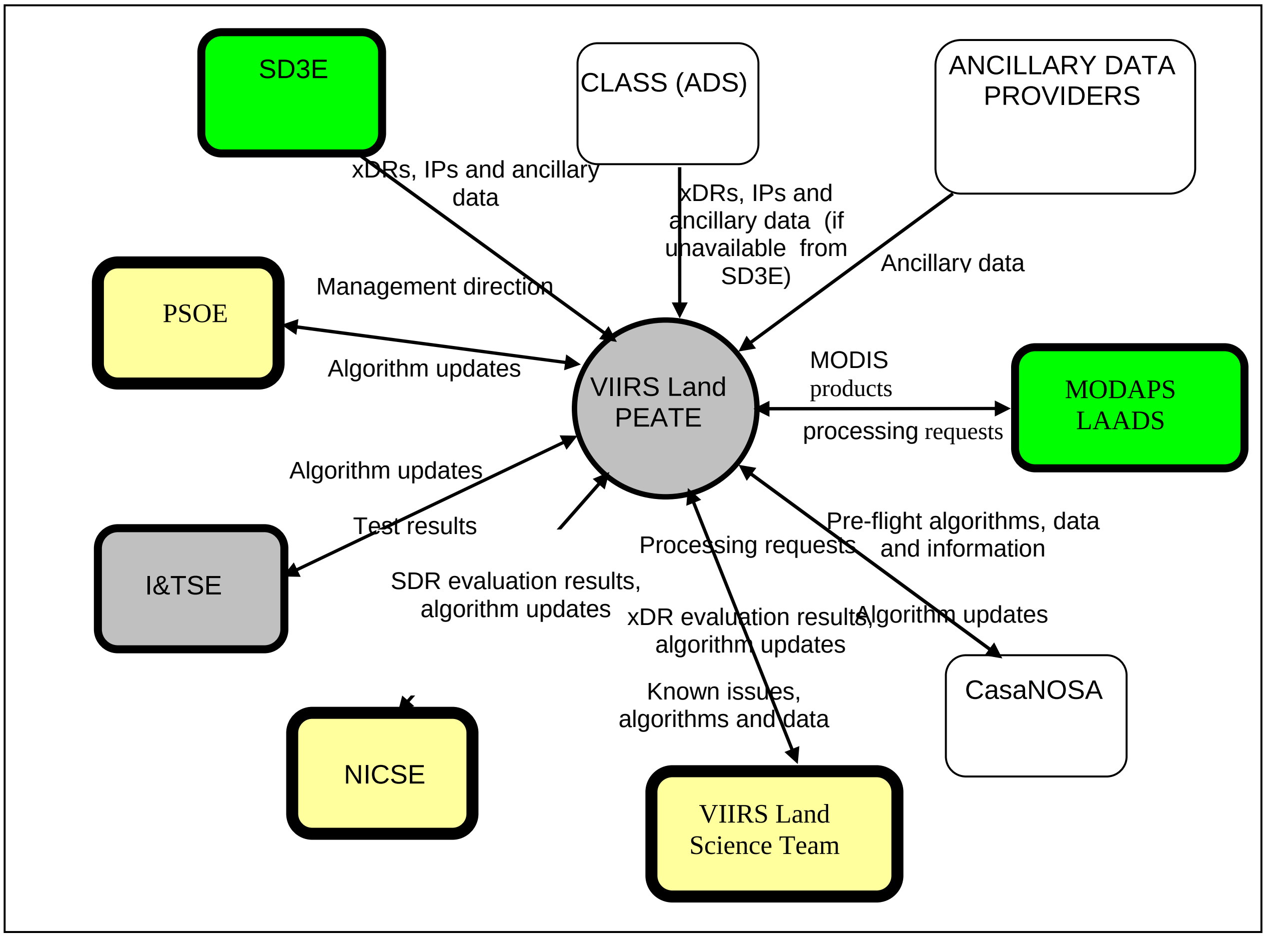

Figure 2.1.3 Land PEATE External Interfaces

SD3E: Nominally, the Land PEATE will acquire VIIRS SDRs and Land xDRs, and operational ancillary data from the SDS Data Delivery Depository Element (SD3E), a component within the Science Data Segment (SDS).

PSOE: The Land PEATE will receive management direction from the Project Science Office Element (PSOE). It will send instrument service requests and suggestions for algorithm updates back to the PSOE. Communication with the PSOE will likely involve e-mail and web pages.

CLASS (ADS): Although many VIIRS-related operational data files will be received by the PEATE from the SD3E, the PEATE will also have the capability to retrieve files directly from the NOAA Comprehensive Large Array-data Stewardship System (CLASS) Archive and Distribution System (ADS). Retrievals from CLASS will be done on an ad-hoc basis. This may be necessary to replace lost files or to acquire other data stored in the archive. This interface will not be used for nominal operation.

Ancillary Data Providers: The Land PEATE will acquire various ancillary data sets from a variety of external providers when the ST will need such data. It is expected that candidate algorithm improvements may require different ancillary data than the operational ancillary data obtained from the IDPS via the SD3E.

MODAPS/LAADS: The Land PEATE will obtain MODIS Level 1, Atmosphere and Land products from the MODIS Adaptive Processing System (MODAPS) production system and the Land and Atmospheres Archive and Distribution System (LAADS) for use in comparison with SDR and EDR products from VIIRS.

CasaNOSA: Algorithms, pre-flight test data, and other information such as Quality Assurance (QA) data will be available from CasaNOSA ("home" of NOAA Observing System Architecture). The Land PEATE will acquire various items during the pre-launch time frame from this resource. The Land PEATE will also deliver algorithm changes into a Configuration Management (CM) system located within CasaNOSA as approved by the PSOE.

VIIRS Land ST: The Land PEATE will be the primary facility for analyses and evaluations performed by the NASA NPP VIIRS ST. The PEATE will provide access to data and tools for ad-hoc analysis of xDRs and algorithms. The Land ST will use the PEATE for development, implementation, and test of algorithm improvements.

NICSE: The Land PEATE will be a facility for analyses and evaluations performed by the NICSE. The PEATE will provide access to data and tools for ad-hoc analysis of the VIIRS SDRs and algorithms. The NICSE will use the PEATE for development, implementation, and test of algorithm improvements.

I&TSE: The SDS Integration and Test System Element (I&TSE) will provide shared resources to all PEATEs that would not be cost effective to replicate within each PEATE. Included will be access to a test environment (the "mini-IDPS") in which original IDPS software will be examined and analyzed. Potentially improved algorithms generated by the ST will be tested in the I&TSE. The interface will be a secure remote interactive login access from the Land PEATEs into the I&TSE subsystem.

2.1.3 Science Analysis Facility

The Land VIIRS PEATE will perform two principal functions: supporting the evaluation of xDRs by the ST and the NICSE, and supporting these groups in generating science algorithms of improved quality. The major functions associated with the former are:

- Acquiring the xDRs from the S3DE and CLASS and archiving the products for subsequent access by the ST and the NICSE. The PEATE will archive all RDRs and SDRs and EDRs for approximately 60 datadays. If IDPS-generated SDRs or EDRs will be required by the ST from outside of the period archived at the Land PEATE, they may be reacquired from CLASS.
- Archiving the ancillary data products and, if necessary, acquiring additional products from the data providers.
- Acquiring and baselining the operational codes utilized at the IDPS and replicating the xDRs obtained from the IDPS within the PEATE
- Distributing the xDRs to ST and NICSE staff to support their evaluations.
- Generating tools for the ST and NICSE to support their evaluations.

- Generating and distributing Diagnostic Data Records (DDRs) including non-VIIRS data sets (e.g. the Moderate-resolution Imaging Spectroradiometer, MODIS) to support their evaluations

With respect to the support of algorithm improvement, the major functions performed within the Land PEATE are:

- Providing an environment in which the ST and the NICSE can modify the VIIRS algorithms.
- Interacting with the ST and NICSE staff to determine the nature and extent of the science tests they wish to perform.
- Archiving, and if necessary acquiring, ancillary and orbit and attitude inputs to support the tests.
- Generating any(Intermediate Products generated within the PEATE (xIP) data not available from the SD3E/CLASS.
- Executing the science tests, archiving the resulting data products, and distributing these products to the ST and the NICSE. The Land PEATE will have the capacity to generate all Land VIIRs products (see Section 2.1.4.2) from RDRs at the approximate rate of 4 datadays per calendar day.
- If necessary, generating and distributing supplementary data sets (e.g. MODIS) to support the algorithm enhancement.
- Performing QA on the science test products in support of the ST and NICSE staff.

The Science Analysis Facility includes the interface processes between the PEATE and the ST and NICSE. These processes include the requests from the ST/NICSE for PEATE services and the provision of data products, software, and data evaluations by the PEATE to the ST/NICSE.

2.1.3.1 Interaction with the ST

The ST will independently assess the xDRs. The ST will receive VIIRS standard products generated at the IDPS from the Land PEATE; specifically SDRs, EDRs and IPs (Intermediate Products). The Land PEATE will also produce and make available to the Land ST any additional IPs (xIPs) that will be produced but not distributed by the IDPS and the corresponding algorithm operational software and Lookup Tables (LUTs). The ST will evaluate and, if necessary, provide recommendations to the PSOE for enhancements to the EDR and SDR algorithms, software and LUTs. These recommendations will be based on analyses of tests performed by the PEATE at the request of the ST. At any time, multiple versions of each product will be available, including products produced by IDPS and those produced by the Land PEATE in various ST algorithm improvement tests.

In addition to the standard VIIRS products, the Land PEATE will produce a number of DDRs. These will, for example, enable the Land ST to inter-compare the quality of the EDRs to similar products from other instruments (i.e., MODIS) and will support the QA analyses performed by the Land Data Operational Product Evaluation (LDOPE). The Land PEATE will develop software for these DDRs based on algorithms from the heritage instruments.

The Land PEATE will work closely with the Land ST to prioritize the use of the limited Land PEATE resources.

2.1.3.1.1 Integration of Algorithm Changes

Land ST members may find that the quality of an EDR or NICSE SDR updates can be improved with algorithm modifications (software and/or LUT changes). The ST member will work with the Land PEATE Algorithm Software Integrators (ASIs) to create a version of the modified algorithm in the PEATE. This may be done indirectly though email or directly by the ST member making the modification to the software/LUT and delivering an updated version to the PEATE in compliance with the ST"s Software Delivery Guide. The latter is the preferred method as it also enables the ST members to test and evaluate any change at their facility before submitting it to the PEATE. The ASIs will integrate the modified algorithm in to the Evaluation Processing System development environment. The ASIs will also perform standalone tests to ensure that the newly integrated algorithms will produce the expected results. Once these tests have been completed, the new algorithm will become part of the Land PEATE's algorithm software baseline. Further details of integrating algorithm changes are given in Sections 2.1.4.1 and 2.1.4.2.

2.1.3.1.2 Scheduling Algorithm Improvement Tests

The Land PEATE ASIs will work with the ST and NICSE members to schedule one or more science tests to evaluate the algorithm modifications. In most cases, the test will include not only production of the modified products, but also downstream products to ensure that the overall impact of an algorithm change is understood. Because of resource constraints, it is likely that each test will include multiple algorithm changes (including NICSE and VIIRS Atmosphere ST changes). The design of these tests is important because the test results will play a key role in justification for the algorithm change being incorporated into the IDPS.

Each test will be performed on a subset of the entire data record. Both temporal and geographical subsets will be used to limit the total amount of data to be produced and analyzed. For instance, a temporally limited test may be to produce a global data set for two 16-day periods, one in the winter and the other at the peak of the Northern Hemisphere growing season. An example of a geographically limited test would be to produce an entire year's worth of data over specific tile locations that are selected to cover a range of geophysical conditions.

To help avoid confusion, products generated in the Land PEATE tests will be named in the Subversion Version Control Tool (SVN) so that it will be easy to distinguish between the IDPS version and the test version. (Section 2.1.4.1)

During the tests and for a time period after the test completes, the test data will be available to the ST members via the Land Archive and Distribution System (LAADS). (Section 2.1.5.2) Normally, a baseline data set will also be available, either the version produced in IDPS, or data from a previous test.

For some tests, the Land ST may want to make the test results available to the wider Land science community. In this case, the Land PEATE will make the data available to the community through LAADS. The Land PEATE will work with the ST members to ensure that appropriate documentation of the test and algorithm changes will be available on the Land PEATE web site to make the community evaluation meaningful.

Additional details of science tests are given in Section 2.1.4.4

2.1.3.1.3 Generating Diagnostic Data Records

Diagnostic Data Records (DDRs) are used in this document to include two types of products that will be generated by the PEATE to support the ST, the NICSE, and the LDOPE. The first type includes products that will expedite inter-comparisons with data from other instruments and will support the evaluations of VIIRS EDRs. The second type will include special QA products that will run by the PEATE at the request of LDOPE to support the LDOPE analyses of xDRs or at the request of NICSE to support their analyses.

The Land PEATE will work with the ST to develop a set of DDRs to enable easy comparison with products from other instruments. The baseline set of these DDRs will be gridded daily and multiple-day products in a fine resolution grid with the same grid cell size as the gridded IDPS products as well as a coarser resolution grid. The fine resolution products will be produced in 10 degree square tiles to allow for easy ordering and distribution. Each coarser grid product will be at 0.05 km and cover the entire globe. In addition, for polar product evaluation, DDRs for the cryospheric products will be produced in northern and southern polar grids, both in a fine resolution tiled grid and a hemispheric coarse resolution grid.

A starting point for the VIIRS DDRs software will be the MODIS compositing and aggregation algorithms and software that produce the corresponding MODIS gridded products. This software will be modified to work with VIIRS products and then VIIRS specific modifications to the algorithms recommended by the Land ST members will be made.

The Land PEATE will work with both the LDOPE and the NICSE to generate a set of DDRs that will expedite the LDOPE QA of xDRs and the NICSE evaluations of SDRs. Details of these DDRs are given in Sections 2.1.3.3.2.2 and 2.1.3.2.1 respectively.

2.1.3.2 Interacting with the NICSE

The NICSE will independently validate the radiometric and geometric performance of the VIIRS Instrument during the pre and post-launch phases of the NPP Mission. It will interface with the SDS PEATES (Land, Ocean and Atmosphere) for further data analysis and algorithm improvement demonstration. The NICSE will acquire its input data, and operational algorithms and LUTs from the various data providers such as SD3E, CLASS, PEATEs, and C3S. The NICSE will run diagnostic tests on the input calibrations RDRs and SDRs, and will provide recommendations for enhancements of calibration software (SDR) or LUTs. These recommendations will be tested and demonstrated by the PEATEs and the I&TSE to validate changes before being submitted to the PSOE for further review.

The NICSE will interact with the Land PEATE for data acquisition for the following reasons:

- The required data may no longer be available from the SD3E or CLASS
- The PEATE may be running improved L2 algorithms the products from which may be required for NICSE analyses
- The PEATE may be generating routine products such as Control Point Matching that will be required by the NICSE for their analyses
- The PEATE may have generated data products at the request of NICSE using updated LUTs or SDR codes

The NICSE will have the ability to order and acquire data from the Land PEATE by two methods as described in Section 2.1.3.4.1.

2.1.3.2.1 Generating DDRs

The NICSE will require that the Land PEATE run the Control Point Matching DDR in the NPPDAPS processing system. This will require that the Land PEATE process all geolocation SDRs with the Control Point Matching routine and send the output Control Point residual files to the NICSE file server via FTP push for geometric analysis . The NICSE will modify existing Control Point Matching algorithm from heritage instruments, generate improvements to the algorithm, and deliver the modified algorithm to the Land PEATE for inclusion in the NPP Data Adaptive Processing System (NPPDAPS).

2.1.3.2.2 Scheduling Algorithm Improvement Tests

When the NICSE determines the SDR code or LUTs need modification to improve the calibration or characterization of the VIIRS instrument, the NICSE will make changes to the SDR code or LUTs and deliver these changes to the Land PEATE for ingestion into the NPPDAPS. New output granules will be produced using the delivered code and will be ingested into LAADS for NICSE access or will be returned to the NICSE by subscription. Analysis of the results by the NICSE, PEATEs, and I&TSE will form the basis for recommending new LUTs or SDR codes to the PSOE for potential delivery to the operational system.

2.1.3.3 The LDOPE

The LDOPE will perform the following QA functions in support of the ST and NICSE:

- Routine day-to-day QA of samples of xDRs received from the SD3E and CLASS.
- QA on samples of any xDRs or xIPs generated by the PEATE and an examination of the downstream effects of algorithm changes.
- Perform detailed analyses on any QA problems identified with xDR samples.
- Maintain a known-issues web page identifying the results of the QA analyses.
- Support the PEATE science tests.
- Provide recommendations to the ST for algorithm improvements.
- Generate QA tools for internal use and provide such tools to the ST for use at their facilities.

2.1.3.3.1 QA Approach

LDOPE will investigate xDRs for generic QA problems and to limited extent will perform science specific QA of xDRs. The process of generic QA of VIIRS Land xDRs is shown in Figure 2.1.4. The QA process will involve the following three steps and LDOPE will develop various tools to help in each of these:

a. Data Sampling: Given the huge volume of Land xDRs, LDOPE will select a few samples (~ 5 %) of xDRs for investigation using browses, time series analysis of science data statistics over various biomes and Land covers, and file level summary of QA metadata.
b. Data Analysis: Sample xDRs will be inspected using visualization tools and will be analyzed at file level and pixel levels using various data analysis and manipulation tools. If necessary, input data used in making the xDRs will also be analyzed (bottom up approach) and similarly products using this product as input (top down approach) may also be analyzed.

c. Dissemination: Results of QA analysis will be communicated to the ST by email and will be posted as known issues on a web page for future reference by the ST and LDOPE.

2.1.3.3.2 NPPDAPS Support for QA

The NPPDAPS will generate the following DDRs in addition to the xDRs and IPs produced at the IDPS and Land PEATE to support LDOPE QA:

a. QA Logs Data Records (QALDR). The QA log is an ASCII file containing the metadata of an xDR. QALDR is similar to the QA logs produced by the current MODIS Adaptive Processing System (MODAPS) for the MODLAND products. NPPDAPS will be used to generate QA logs for every xDR and IPs produced at the IDPS and for all the xDRs, IPs and DDRs produced at the Land PEATE. These QA logs will be parsed and metadata will be ingested into the metadata database developed and maintained at LDOPE.
b. Coarse Resolution Browse Data Records (CRBDR). For selected xDRs and IPs produced at the IDPS and at the Land PEATE, the NPPDAPS will be used to generate coarse resolution products. LDOPE will generate global browse images from these coarse resolution products. The global browse images will be posted on the PEATE web page.
c. Golden Tile Statistics Data Records (GTSDR). A selected set of xDRs produced at fixed geographical locations, called the golden tiles, will be masked and processed to generate science data statistics. GTSDR is an ASCII dump of the statistics generated by this process. Statistics include mean, standard deviation, minimum and maximum of good quality observations over a selected biome or Land cover. Early post launch GTSDR will be generated at LDOPE since the science algorithm may be changing very frequently. During this period LDOPE will acquire the golden tile xDRs by NPPDAPS subscription. The golden tile xDRs will be archived permanently in LAADS. These xDRs may need to be retrieved for reprocessing of GTSDR with new masking criteria upon request by LDOPE. The science statistics will be ingested into a time series database developed and maintained at LDOPE. LDOPE will generate time series plots of these statistics and will post the plots on a web page hosted by LDOPE.

LDOPE will develop the Product Generation Executives (PGEs) to create the above DDRs and will deliver them to the Land PEATE ASI. LDOPE will also identify the xDRs for which these data records will be created. LDOPE will establish NPPDAPS subscriptions to acquire the data records as they will be generated. Sample xDRs selected for detailed analysis will be ordered using LAADS. If the required xDR is not available, LDOPE will request LAADS Processing on Demand (POD) as described in Section 2.1.5.2.

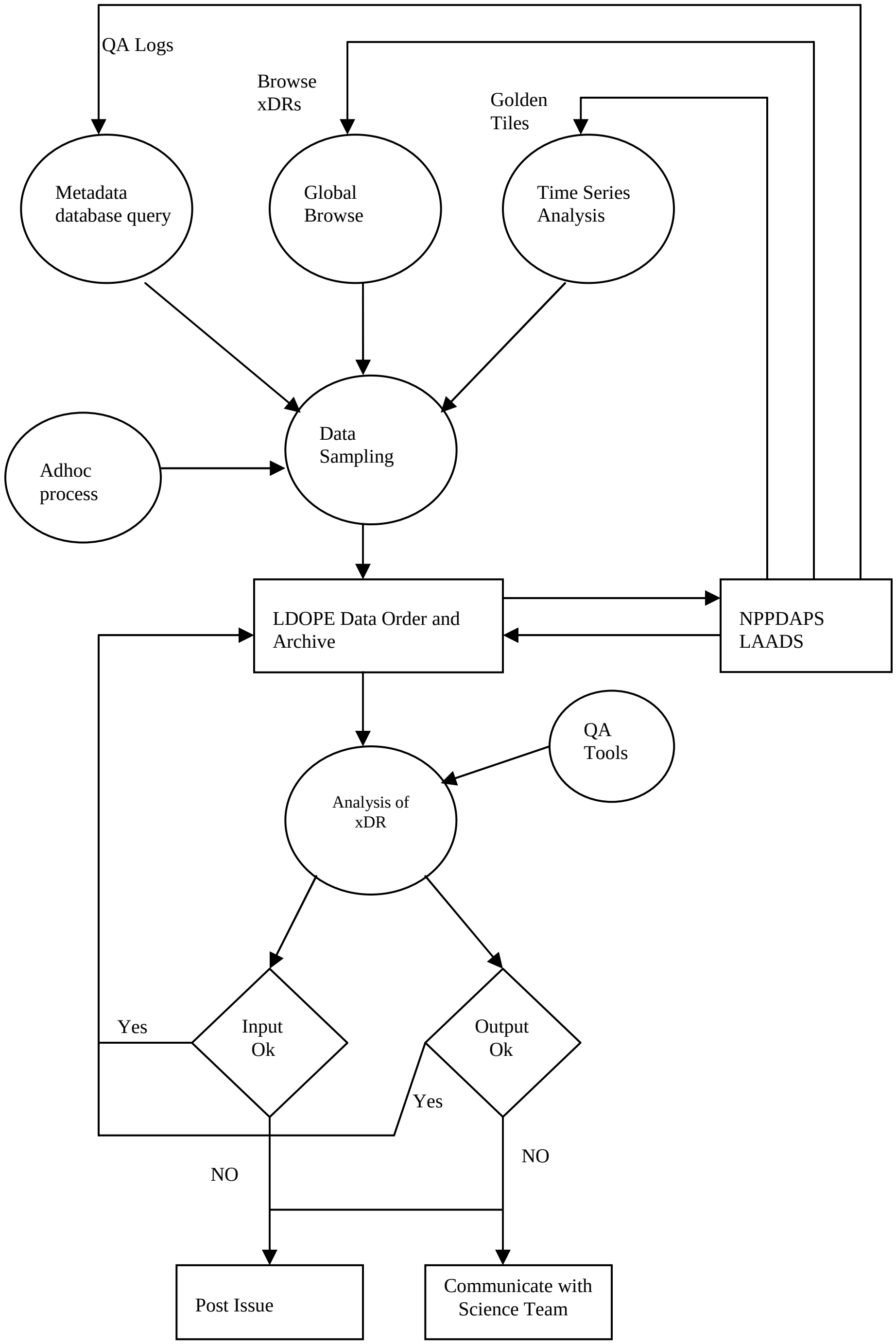

Figure 2.1.4 Generic QA of xDRs

2.1.3.3.3 Pre-Launch QA

Prior to launch LDOPE will use test data to test the components of the QA processing systems, tools and applications. Based on the knowledge of the proxy data used in the pre-launch end to end test, LDOPE will perform QA on the test data in an endeavor to identify obvious problems in the Land science algorithms. These problems will be reported to the ST.

2.1.3.3.4 Post-Launch Routine QA

As part of the post-launch routine QA of xDRs received from the SD3E/CLASS, sample xDRs will be selected either at random, or based on the knowledge of algorithm sensitivity to Land cover/geographic area or by visual inspection of coarse resolution global browse images. Summary metadata in the sample xDRs will be checked against valid values using metadata readers. Sample xDRs will be run through summary data analysis tools before they will be visually inspected for possible QA related problems. The source of problems will be tracked to bugs in the science code, the science process used in making the product, or to the input xDRs used to make the product. Various data analysis and manipulation tools will be used in this QA process. Data problems and source of problems will be posted on the PEATE web site as known issues. Status of the issues will be updated as algorithms will be revised to fix the problem. Time series science data statistics extracted from long time series of Land xDRs over selected geographic area will be used for monitoring the expected seasonal variation in the science parameters and detecting the outliers by fitting appropriate statistical models to the time series statistics data.

2.1.3.3.5 Science Test QA

Science Algorithms used to make the Land EDRs may be revised as a result of the LDOPE QA or ST QA or due to changes in the LUT by the NISCE. Based on recommendation from the ST or NISCE, the Land PEATE will run Science Tests using revised PGEs. LDOPE will validate the algorithm change by comparing the test version of EDRs created using the revised algorithms with the baseline version of EDRs created using the algorithm version run in the IDPS. LDOPE will acquire sample data from the Test System either by standing order or using LAADS interface. The result of the evaluation will be communicated to the ST and the Land PEATE Test Manager (TM) by email and posting on the web.

2.1.3.4 Product and Algorithm Distribution

2.1.3.4.1 Data Distribution

Data will be distributed to the Land ST and the NICSE via the LAADS web ordering interface or by subscription. Both distribution mechanisms will allow the ST member to easily keep various versions of each product separate. When appropriate, it will be possible for the LAADS system to limit the distribution of specific product versions to only the Land ST members, and not the general Land science community.

The LAADS will allow a ST or NICSE staff member to select and order the VIIRS standard products, xIPs and DDRs. The ST member will access the LAADS web interface, use the integrated browse and search capability to find the needed data, and download the data to the ST member's facility. More details on the LAADS are given in Section 2.1.5.2.

Subscription requests will allow Land ST or NICSE members to continuously receive large amounts of data. The ST member will contact the Land PEATE TM and request that, whenever a product is generated, the product be automatically ftp pushed to the ST member's facility. The user can request that the Land PEATE filter the data sent by time, product version and geographic location.

2.1.3.4.2 Software and LUTs Delivery

The Land PEATE will make CM baselined algorithm software and LUTs available to the Land ST and NICSE staff members. The baselines are composed of a set of tagged/labeled configuration items

(CIs), such as source code that are used to compile and generate a consistent set of executables, and documentation that together define the software at a specific point in time. The primary mechanism for algorithm software delivery will be through a SVN repository. An alternate path will be to provide a tar file containing both algorithm software and LUTs on an ftp server in the same manner that is currently done for MODIS operational software. Further details of the configuration control procedures to be used by the PEATE are given in Section 2.1.4.1.

2.1.3.4.3 Providing Software and LUTs to the PSOE

When the science test results for an algorithm change become available and have been reviewed and approved by the ST, a recommendation will be made to the PSOE for inclusion of the algorithm change into the IDPS. This recommendation will contain supporting material from the science testing. If the PSOE approves the change, the Land PEATE will add the software/LUT change to the Land PEATE branch in the CasaNOSA SVN repository. The Land PEATE will also maintain a website that contains descriptions of the changes approved by the PSOE.

2.1.4 Engineering Support System

The ST and NICSE will be required to evaluate and validate xDRs and to develop enhancements to the operational algorithm codes. The Engineering Support System will provide the internal Land PEATE infrastructure support for meeting these requirements of the ST and the NICSE. Details of the functionality associated with this infrastructure are provided in this section.

Figure 2.1.5 illustrates the flow of xDRs and IPs into and out of the Land PEATE. The SD3E will provide the principal source of data products for the PEATE. However, CLASS will be used in the event that data will be lost or corrupted at the PEATE and will be no longer available from the SD3E. The PEATE will distribute xDRs, and xIPs to the NICSE and the ST including data obtained from the SD3E, supporting DDRs generated by the PEATE, and products generated at the PEATE to test new algorithm codes. Figure 2.1.6 identifies the flow of VIIRS algorithm codes into and out of the PEATE. The CasaNOSA system will provide the only source of codes that will be running in the operational IDPS system. These codes will be baselined in the PEATE and will be accessible by the NICSE and the ST. The process of improving algorithms will involve an iterative exchange of algorithm versions and test products between the PEATE and the ST and NICSE. Following the approval of a new algorithm version by the ST, the code will pass through a series of gates, testing, and reviews shown in Figure 2.1.6 prior to the possible introduction into the operational IDPS system.

In order to develop improved algorithms the ST will develop prototype algorithm codes that will be incorporated into the Evaluation Processing System for subsequent testing. The software integration and test infrastructure described in this section focuses on the acquisition of the operational algorithm codes and associated test data from CasaNOSA, the development of prototype algorithm codes, the integration of these codes into the NPPDAPS, and the test processes applied to the algorithm codes.

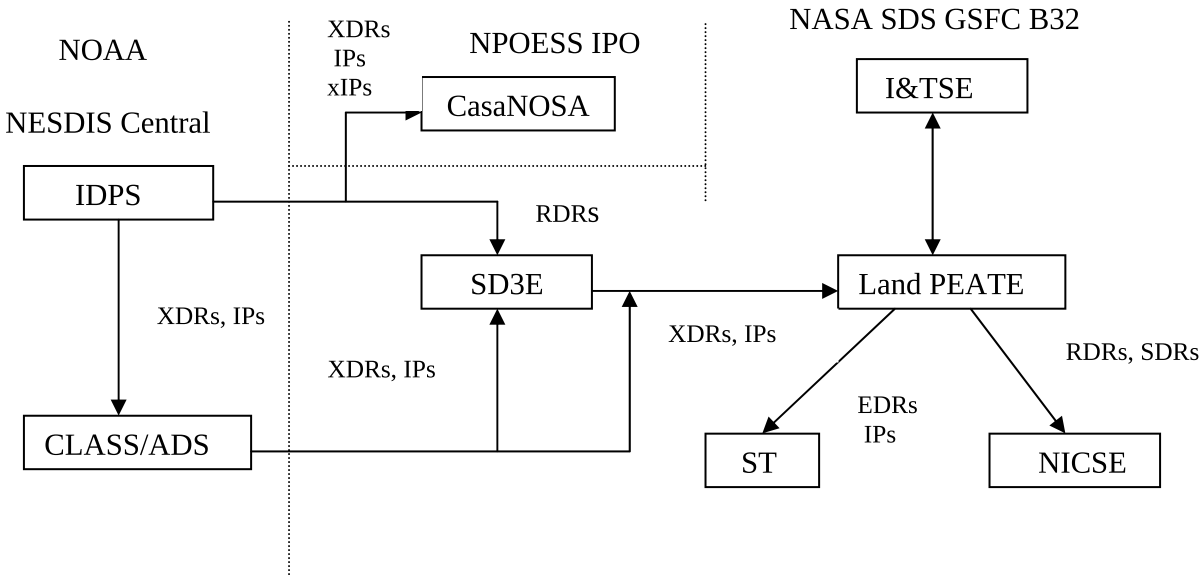

Figure 2.1.5 Land VIIRS Product Flow

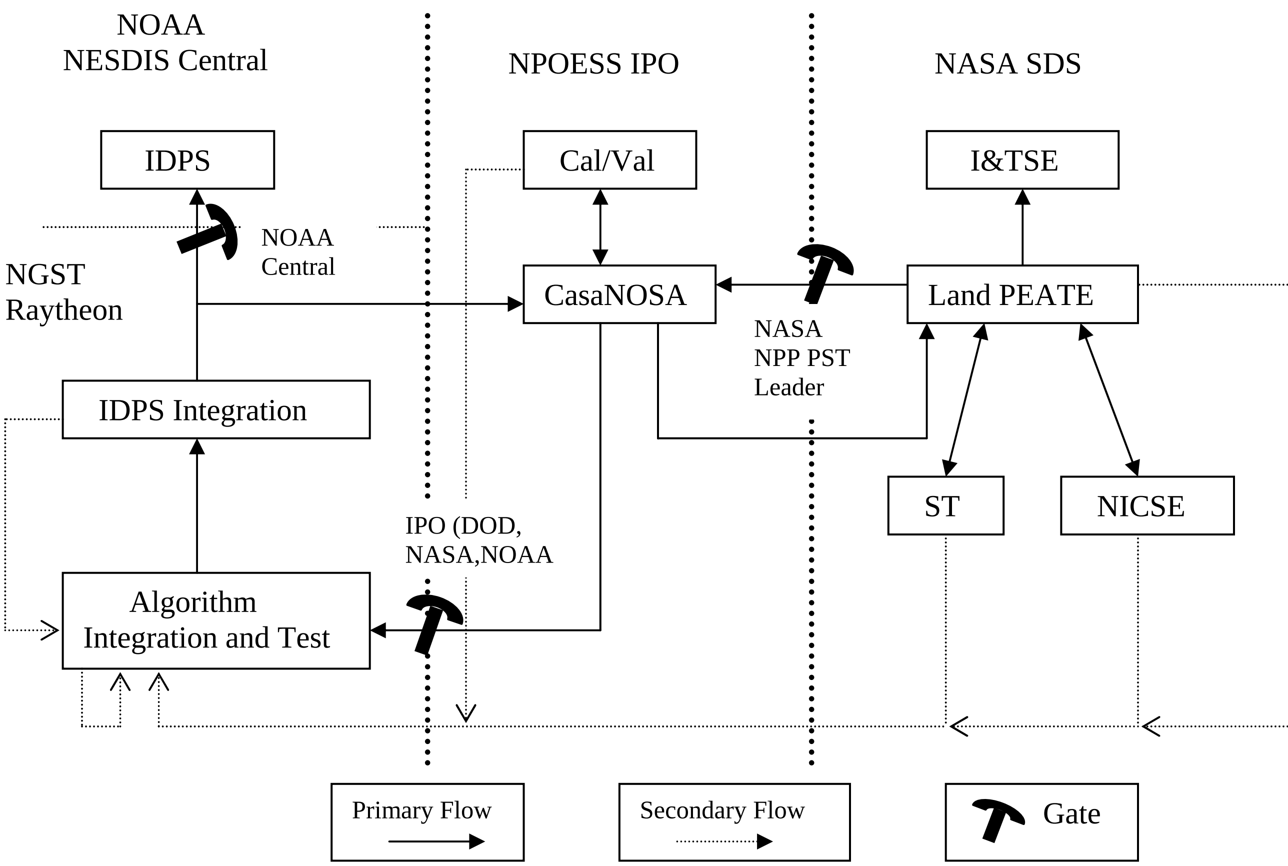

Figure 2.1.6 Land VIIRS Algorithm Flow

To the extent possible the approach taken for the Engineering Support System leverages against the Aqua and Terra MODIS project experiences. However, a number of new procedures and software systems will be utilized to reflect the different requirements for the Land VIIRS PEATE. Specifically, the proposed approach will expedite the development and testing of prototype algorithm codes and will facilitate access to test results for these codes and the xDR data.

The Section 2.1.4 sub-sections will present the functionality associated with the following:

- Configuration management – Section 2.1.4.1
- Software development – Section 2.1.4.2
- Integration and Testing – Section 2.1.4.3
- Science Testing – Section 2.1.4.4
- I&TSE Interaction – Section 2.1.4.5
- Document Library – Section 2.1.4.6
- Web Site – Section 2.1.4.7

2.1.4.1 Configuration Management

For many years the MODIS project has utilized the ClearCase system for configuration management of the MODIS algorithm codes, documentation, and the MODAPS processing system. In more recent years the freeware Concurrent Versioning System (CVS) has been used for configuration control of many parameters associated with MODIS production. A trade study for ClearCase and the CVS follow-on system Subversion (SVN) has indicated that the SVN system is more suited for the land VIIRS PEATE activity. There are a number of reasons for this. These include the fact that SVN is freeware, it is utilized by CasaNOSA that is the source of the VIIRS operational codes, and it provides a simple open-architecture environment that will expedite the development and testing of prototype codes developed by the ST and the NICSE.

SVN will be used to track and control operational and prototype algorithm codes, test data sets including science test data sets, LAADS, the NPPDAPS, and documents. As will be discussed in Section 2.3.1, Current Operational Example, science algorithm codes are presently being tested and these are being tracked using SVN. SVN can store software source code, text and binary files and has superior performance at versioning whole directory trees. SVN encounters difficulty handling large files, including binary and test files such as software look up tables, which degrade the system performance sufficiently to make its use impractical. A similar problem was encountered on the MODIS project where it was necessary to administer large coefficient files outside of ClearCase. This approach will be adopted for the land PEATE which will include a versioned repository not implemented in SVN but tightly coupled with SVN. The non-SVN repository will have a simple directory structure organized in the same manner as SVN and enhanced with version numbers similar to SVN's internal version numbers. Users will have the same level of access to both repositories.

The ST members and the NICSE staff will have access to the same SVN directory structure as the land PEATE staff. This will expedite the development and testing of prototype algorithms and the access to test data sets. In SVN, separate branches (directory paths) will be kept for algorithm versions running in the IDPS, NICSE and PEATE. Branching, a workspace management mechanism will give users the ability to easily retrieve and compare data from various sources.

The configuration management system will be accessible in two ways. The first method will be web-based using a web browser and will provide read-only access. All files in SVN will be accessible using ViewVC and the non-SVN repository will be accessible as a static directory structure. The second access method will be from the UNIX command line and will provide both read and update capability. Access will be possible from remote locations such as developers' workstations or other facilities located worldwide. Command line access to any single repository will be limited to a group of authorized users with login privileges.

2.1.4.2 Software Development

The NPP/VIIRS code integration team will be charged with the task of adapting operational code (or OPS code) to run in the NPPDAPS. The modifications to OPS code will be to modify input/output portions of the OPS code to use disk files through a set of toolkit routines similar to those used in MODAPS. A complete description of the OPS code that will be utilized at the PEATE appears in Section 2.1.4.2.1 and a description of the toolkit routines is provided in Section 2.2.4.2.5.

2.1.4.2.1 Processing Chains

The Land PEATE will use web-based utilities to transfer code and associated test data and documentation into one of the Land PEATE test environments for integration and testing.

Table 2.1.1 provides a complete list of proposed PGEs for the Land VIIRS. A number of these PGEs have been ported to the NPPDAPS and tested with associated PGE scripts (Section 2.3.1).

Table 2.1.1 NPP/VIIRS PGE Algorithms

PGE Name	PGE Description	Type of Output Product
PGE301	Geolocation	IP
PGE302	Radiometric Calibration	SDR
PGE303	Cloud Mask	IP
PGE304	Aerosol Optical Thickness	EDR & IP
PGE306	Cloud Optical Properties	IP
PGE307	Snow Cover	EDR
PGE308	Sea Ice Characterization & Ice Age	EDR
PGE311	Land Surface Reflectance	IP
PGE313	VIIRS Daily Surface Reflectance Collection Gridding	IP
PGE314	VIIRS Snow/Ice Cover Gridding	IP
PGE315	VIIRS Previous Ice Age Gridding	IP
PGE316	Land Surface Temperature	EDR
PGE317	VIIRS Quarterly TOC NDVI Gridding	IP
PGE318	VIIRS Monthly Product CV-MCV Gridding	IP
PGE319	VIIRS 17-Day Land Albedo IP Gridding	IP
PGE330	Active Fires	EDR
PGE341	VIIRS Quarterly Surface Type Gridding	IP
PGE349	Surface Type	EDR
PGE350	VIIRS National Centers for Environmental Prediction (NCEP) Global Forecast System (GFS) 750m Granulation	IP
PGE351	VIIRS NOGAPS 750m Granulation	IP
PGE352	VIIRS Global Land Cover 750m Granulation	IP

PGE Name	PGE Description	Type of Output Product
PGE353	VIIRS Gridded IP 750m Granulation	IP
PGE354	VIIRS Gridded IP 375m Granulation (Previous Ice Age IP Granulation)	IP
PGE355	Land Albedo	EDR
PGE356	Normalized DifferenceVegetation Index (NDVI)	EDR
PGE373	Ice Surface Temperature 750m	EDR

Following the complete integration of these codes, the following PGE processing chains will be developed:

- L1 and Granulation
- L2 Cloud and Active Fires
- L2 Land
- L2 Ice
- 5-minute Gridding
- Daily and Multi-day Gridding

The PGEs chains presented above include granulation PGEs that will place gridded input data into swath coordinates expected by the code, and gridding PGEs that will place outputs into time-averaged global files. Complete documentation of these chains will be given in the Land PEATE VIIRS Science Data Processing System Description document [3]. An example of the PGEs involved in one of these chains is illustrated in Figure 2.1.7. This figure illustrates the proposed processing chain for the EDR (Level-2) Ice PGEs. This chain will include Ice Quality (PGE370), Surface Temperature (PGE371), Ice Surface Temperature (PGE373), Ice Concentration (PGE374), and Sea Ice Characteristics/Ice Age (PGE308). Interdependency is clearly evident in this figure as Ice Quality is input into Ice Concentration which in turn is input into Ice Surface Temperature and Sea Ice Characteristics/Ice Age. These PGEs also will use granulated inputs for processing the respective outputs.

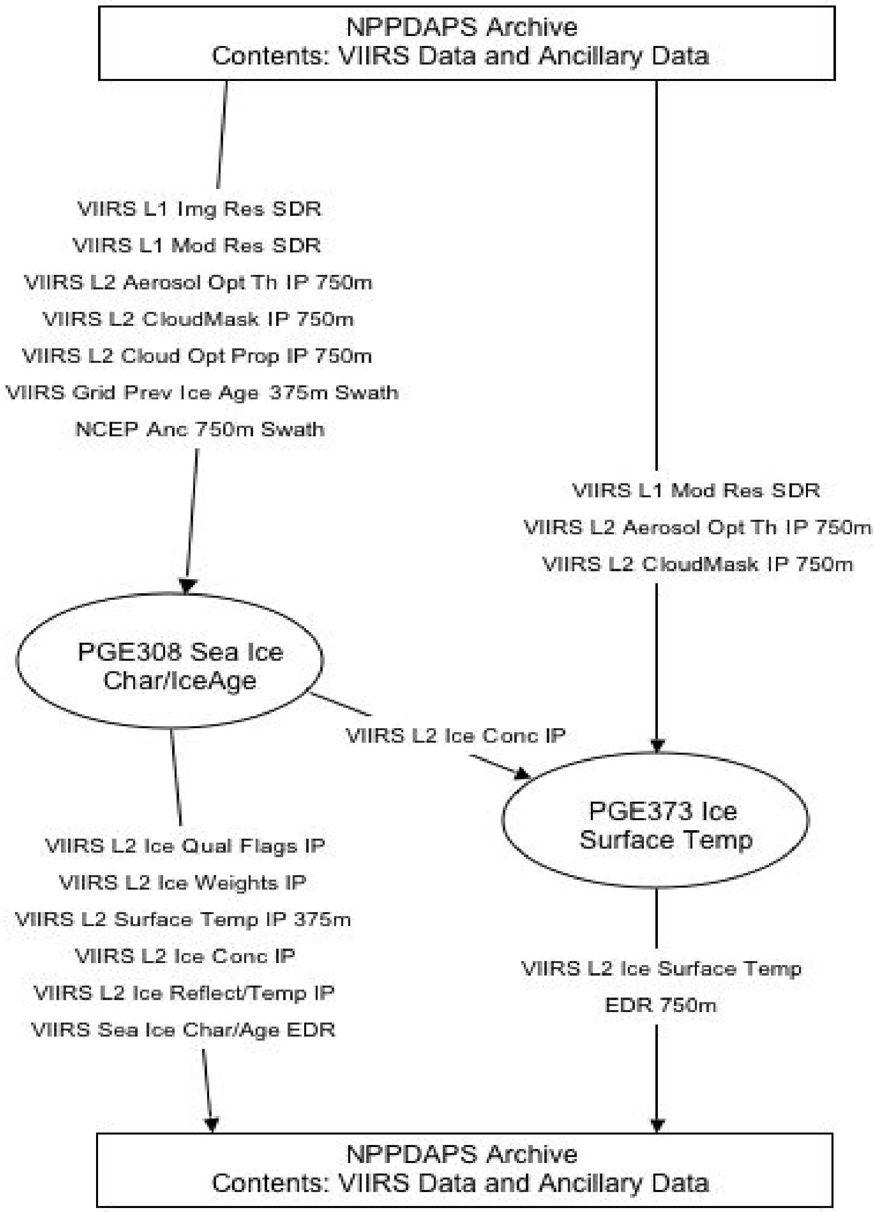

Figure 2.1.7 Land PEATE Operations Code PGE Chain for L2 Ice

2.1.4.2.2 Code Ingest

For NPPDAPS code integration, the open-source versioning utility, SVN, will be used to track and version source code and associated documentation (Section 2.1.4.1). VIIRS code changes will be autonomously checked for validity and scripting techniques will be implemented to ingest and version VIIRS code deliveries into the SVN system.

During the NPPDAPS integration process, the integration team will assign version numbers to the code and associated documentation. This versioning scheme has already been implemented for VIIRS and the versions have been documented in history files for the PGE chains listed above. An example for PGE311 is given in Figure 2.1.8

Figure 2.1.8 Sample PGE History File

```
HISTORY.txt for NPP PGE311 (Land Surface Reflectance Algorithm)
------------------------------------------
This file shows the following:
(a) What was changed in the PGE
(b) Why was it changed
(c) How the output product will be affected by the change
(d) The data of the change.

V1.0.3                                  4/14/05
==================================================================
- Added AeroLut_4_ScattInc_8_Model.LUT LUT to PGE script
- Removed hard coded LUT paths:
my $StaticInputFiles =
[
   { LUN => LANDCONFIG_LUN, files => ["PGE311/LandModule_Config.dat"] },
   { LUN => SURFCONFIG_LUN, files => ["PGE311/SurfReflect_Config.dat"] },
   { LUN => SURFREFL_LUT_LUN, files => ["PGE311/SurfReflect_LUT.dat"] },
   { LUN => AERO_LUT_LUN, files => ["PGE311/AeroLut_4_ScattInc_8_Model.LUT"] }
];
- Provided option of one or two inputs for the following ancillary data:
   NCEP ozone or OMPS ozone
   NCEP precipitable water or EDR precipitable water
   NCEP surface pressure or NOGAPS surface pressure

V1.0.2                                  1/25/05
==================================================================
- Renamed process from MOD_PRefl to NPP_PRefl
- Populate filenames from GetParam routine
- Add Surface Refletance imagery and moderate SDR

V1.0.1                                  12/8/04
==================================================================
- Implement TK Lim's method creating a modified PCF file

V1.0.0                                  11/12/04
==================================================================
- Initial delivery from developer
- Modified routines to read from PCF file
```

2.1.4.2.3 Operation Code Development

The Land PEATE will acquire operational algorithms from CasaNOSA or the ST by using SVN scripts to copy and verify the ingestion of this code into NPPDAPS. The Land PEATE will then adapt operational algorithms to run in NPPDAPS by replacing calls that access memory objects with calls to routines that read and write disk files. A common set of routines that read and write files in HDF 5 format will be used to perform I/O operations for PGEs. PGEs will then be integrated and baselined in NPPDAPS. Following this the Land PEATE will endeavor to replicate xDRs to confirm and validate the integration. The Land PEATE will also produce science products from the OPS code for analyses by the ST.

2.1.4.2.4 Associated Delivery Documentation

Developer-produced production rule and packing list documentation will be provided with VIIRS algorithms. These documents will be tracked using the SVN. In addition to the delivered documentation, the PEATE will maintain documentation in the form of HOWTO, README, code change history files, and production rule files described in more detail below.

2.1.4.2.5 Auxiliary Documentation

The Land PEATE will maintain and version several sets of documents using SVN. Configuration list files (or ciLists) which specify the version numbers of the operation code and associated shared code, libraries, include files, and documentation will be used. The ciLists will be read by scripts during the code baselining step to assign configuration labels required for code configuration.

Some production rule documentation will be delivered with the IDPS algorithms obtained from CasaNOSA and by the ST algorithm developers. In latter case, frequently interactions between the Land PEATE staff and the ST members will lead to the correct identification of production rules which will be documented by the Land PEATE staff. In addition to production rules, build instructions will be produced in conjunction with algorithm developers to provide pertinent information on the creation of executables. All associated documentation will be managed under configuration control.

2.1.4.2.6 Code Builds

As part of the NPPDAPS integration work, the required build files will be modified and tailored for the NPPDAPS environment. These modifications will be handled via build scripts that point to appropriate libraries and include file areas. Executable builds will be verified against developer builds via extensive unit testing in a Linux environment.

2.1.4.2.7 Unit Tests

Unit tests will be run in a Linux environment using test data provided by developers and independent test data obtained off line. The tests will be driven by the PGE scripts which will be developed by the Land PEATE ASIs. The PGE scripts will perform a number of functions including the following:

- Specify static lookup tables
- Specify output filenames and associated ESDTs
- Specify runtime variables
- Generate Process Control File (PCF)
- Invoke the executable

- Set archival of output products
- Add metadata where appropriate to output products

As noted above, the PGE scripts in conjunction with NPPDAPS software will produce a PCF which will control the input/output and runtime environment of the executable. Operationally, the PGE scripts will be run in combination with loader scripts, which will control the staging of input data. The loader scripts will be developed by a joint effort of the ASIs and the NPPDAPS staff. These scripts will reflect the production rules which will be documented by the integration team with assistance from the algorithm developers.

Several types of tests will be performed to validate the science code and the associate PGE scripts and loader scripts. PGE scripts will be validated with command line tests, and loaders will be validated with NPPDAPS database driven tests. Several scripted and graphical utilities will be used to verify the subsequent results from these tests. Code developers will be contacted if the verification process reveals problems or inconsistencies.

2.1.4.3 Integration and Testing

As discussed in Section 2.1.4.2, the operational and prototype codes will be unit tested from the command line and in the NPPDAPS environment using a few granules of input data. This process will confirm that the test data sets provided with the algorithm codes can be replicated. This unit test process will be followed by an independent Integration and Test (I&T) process that will perform chain tests with the algorithm using standard sets of downstream input products that will be approximately an orbit in duration. The I&T will be conducted using the NPPDAPS. The I&T process will be system as opposed to science oriented. Checks will be performed to ensure that metadata fields will be filled correctly, that the log files will contain no error messages, that output products will be correctly ingested, and that the output file sizes will be as expected. From the MODIS experience with Land algorithms, approximately 10% of the codes will fail the I&T process and will be referred back to either the unit test phase or to the developer. The I&T process will identify the test status on the web site (Section 2.2.4.5), will utilize the Bugzilla to track and report any deficiencies identified in the algorithm codes, and the SVN system to pass codes forward for subsequent testing.

In addition to testing algorithm codes, the I&T function will include functional, acceptance, and performance testing of new releases of the LAADS and the NPPDAPS.

2.1.4.4 Science Testing

Science testing is a major component of the Land PEATE activity and is the process by which comprehensive test data sets will be generated to support the ST and the NICSE in their evaluations of the xDRs and their development of improved algorithm codes. It is expected that science tests will range from those involving small numbers of algorithms and short time intervals to larger scale chain tests using many algorithm codes that will be processed over extensive periods of time as specified by the ST and NICSE staff. It is anticipated that the larger scale tests will involve the generation of multiple TeraBytes of data products and may take several weeks to complete. The following functions will comprise science testing:

- PEATE staff will collect all of the ancillary data necessary to support science test activities.
- The Land PEATE will maintain the xDR archive.

- PEATE staff will work with the ST and the NICSE staff to develop “golden” RDR datasets (e.g. 16-day intervals) that can be used in a series of science tests to facilitate the evaluations. However, staff will have the capability of using the proxy generator to create input datasets for any time periods required by the ST and the NICSE.
- Following definition of the content of the science test, PEATE staff will generate a science test plan that will be published on the Land PEATE web site (Section 2.2.3.5). This plan will include test objectives, test schedule, algorithm versions to be executed, test time interval, and evaluation status. The web site will be updated as a test passes from planned, to running, to complete. Each test will be assigned a test number that will be entered into SVN.
- The Land PEATE will acquire the algorithm versions and input data sets from SVN and will execute the test using the NPPDAPS. The tests may involve the generation of “baseline” datasets to facilitate the evaluation of new prototype algorithms. The test results will be entered into LAADS.
- The data products generated by a science test will be entered into the LAADS (Section 2.1.5.2). This system will be the principal mechanism for distributing data to the ST, the NICSE, and the LDOPE (Section 2.1.3.3). PEATE staff will reconcile the data generated by the NPPDAPS and ingested into the LAADS to ensure that all products will be available for distribution. The data products will be maintained on disk in LAADS to expedite future inter-comparisons until permission is obtained from the ST, the LDOPE, or the NICSE to delete the data sets.
- The Land PEATE will re-generate any required data using the processing-on-demand feature in LAADS.
- PEATE staff will provide user support services for the ST and the NICSE. This support will range from logistic support relating to LAADS to science support concerning data products.
- The LDOPE component of the Land PEATE will perform QA on the science test data sets.

2.1.4.5 I&TSE Interaction

The I&TSE (“mini-IDPS) will include operational IDPS software and baseline versions of the VIIRS algorithms used at the IDPS. This element will provide a resource to all PEATEs to test potential algorithm enhancements in an IDPS-like environment after the ST or NICSE has established that the new algorithm version has increased science capability. These tests will be systems oriented and will establish if a new algorithm will require increased or decreased operational resources. It is expected that I&TSE will also perform baseline tests using the existing IDPS algorithm versions.

As shown in Figures 2.1.5 and 2.1.6 the Land PEATE will provide all necessary xDRs, IPs, test data, and algorithms to the I&TSE to support the testing. The Land PEATE testing staff will support the I&TSE in their evaluations of the test results and will report on these evaluations to the ST or NICSE through the Land PEATE web site (Section 2.1.4.7).

The process by which the Land PEATEs request the use of the I&TSE resources is presently unknown. However, it seems probable that the use of the I&TSE resources by the Land PEATE will be a matter of negotiation between the managements of the two elements.

2.1.4.6 Document Library

The Document Library will be an organized repository of all electronic documents that will be either generated within the Land PEATE or will be of sufficient interest to the ST to retain a local copy. This library will be an integral part of the Land PEATE’s CM system so that multiple versions of any document will be stored and readily accessible to all groups with access to the CM repository.

The Document Library will be accessible using ViewVC or a Command Line interface to the CM System. Documents generated within the Land PEATE may be updated as subsequent versions become available.

2.1.4.7 Web Site

The Land PEATE will provide a single access point for all information pertaining to the Land PEATE activities. A wide variety of information will be provided including status of actual and planned science tests, Land PEATE system status, and contact points for Land PEATE, NICSE, and ST staff members. The web site will provide access to the CM system, LDOPE, and the document library. It will also provide a portal for science test data sets. Login privileges will be provided for certain types of access. The site will also host a discussion forum for the ST members to expedite xDR evaluation and the development of prototype algorithms.

2.1.5 Evaluation Processing System

The Evaluation Processing System includes the NPPDAPS for the generation of xDRs using IDPS and ST/NICSE algorithms and the LAADS for the archive and distribution of xDRs to the ST, NICSE, and LDOPE. These systems are discussed in the following sections.

2.1.5.1 The NPPDAPS

The Land PEATE will use NPPDAPS to generate data products required by the ST, NICSE, and LDOPE. The system will rely heavily on the MODAPS heritage. NPPDAPS will have the following capabilities:

- To import and archive NPP xDRs, IPs, ancillary data, LUTs, and engineering data from various sources and make them available to the ST, NICSE, and LDOPE.
- To integrate operational algorithms and process them to replicate the IDPS operational products.
- To integrate science codes from the ST and process them to generate products for the ST to evaluate the algorithms changes.
- To integrate calibration algorithms and enhanced SDR algorithms from NICSE and generate the test SDR for NICSE.
- To generate xIPs and DDRs as required by the ST, LDOPE, and NICSE to support their evaluations of xDRs and science algorithms.

To support the ST in assessing the EDRs, NPPDAPS will be able to import and archive VIIRS standard products, including xDRs, IPs, and ancillary data. Since the data and algorithms will be available from various places, such as CasaNOSA, CLASS, IDPS, and SD3E, NPPDAPS will have multiple external interfaces to provide a timely, stable processing environment to ingest and archive the data. The NPP Land operational algorithms will be integrated with a toolkit to handle input and output by Land PEATE Algorithm Integration Team so they can be processed in NPPDAPS to replicate the operational xDRs. The ST will receive the integrated algorithms from NPPDAPS and make code modifications and enhancements. When the ST delivers enhanced algorithms, the Land PEATE will integrate them in NPPDAPS and will run a variety of science tests as determined by the ST to support their algorithm evaluations. All algorithms will be baselined in the SVN repository, and all the data will be transferred and archived to LAADS for the distribution to ST.

NPPDAPS will also be used to support NICSE to validate the radiometric and geometric performance of the VIIRS instruments. All NPPDAPS archived data will be provided to NICSE at their request. When NICSE needs to test new SDR algorithms and/or LUTs, the algorithms and/or LUTs will be delivered to Land PEATE and integrated to NPPDAPS, and specific granules will be processed with the new code and/or LUTs to generate the test SDR that will be sent back to NICSE for code and LUTs validation.

The LDOPE will perform QA on the Land EDRs generated by the Land PEATE and the xDRs received from the SD3E. When EDR algorithms will be modified and updated due to QA issues, the new algorithms will be integrated to NPPDAPS and processed to generate new EDR that will be delivered to LDOPE who then will compare the test EDR data with the standard EDRs data produced by IDPS, and validate the new algorithms.

NPPDAPS will effectively manage multiple versions of algorithms and multiple data sets with unique ArchiveSets. Consequently, NPPDAPS will be able to process any version of algorithms with any available set of data. This will be required to support the ST, NICSE and LDOPE in effectively cross-examining and validating algorithms and evaluating xDRs.

2.1.5.2 The LAADS

LAADS will be used to perform two functions. First, all xDR, IP, and ancillary data products received from the SD3E and CLASS will be archived in LAADS for subsequent access by the ST, NICSE, and LDOPE. Second, as tests will be conducted with NPPDAPS using updated science algorithms provided by ST and NICSE staff members, LAADS will provided the principal mechanism for the distribution of test products from the PEATE to the ST, the NICSE, and the LDOPE. In support of these functions, it may be necessary for the Land PEATE to acquire ancillary data from the data providers (Section 2.1.2) or generate DDRs using non-VIIRS sources (Section 2.1.3.1.3). Such products will also be archived in LAADS.

It is expected that all test products will be transferred from the NPPDAPS to LAADS at runtime. All data will be maintained on disk until such time as they will be released by the ST, NICSE, or LDOPE. It is possible that LAADS will have insufficient disk to hold all of the data products and test data sets required by these groups. In this event selected data products that have relatively low utility will be deleted by agreement with the users. LAADS has a processing-on-demand (POD) capability that will allow these products to be re-generated if necessary. It is expected that such products would be re-generated for only a subset of the original test interval.

The LAADS includes a variety of features that will support the evaluation of the xDRs and the development and testing of new prototype algorithms. These include:

- Geographic, temporal, local granule ID, product version, and tile-based searches
- Parameter and geographic subsetting
- Reprojections (12 options)
- Mosaicing (i.e. splicing granules and tiles into a single file)
- Masking (i.e. cutting out irregular shapes such states and coastal zones)
- Conversion to geoTIFF format
- Metadata searches
- Data push and pull options and direct ftp access
- Shopping cart
- Data subscriptions including subsetting

- Password-based access

Ensuring that the requirements of the end users will be well reflected in the development of LAADS has been, and continues to be, an essential part of the approach used for the system evolution. This process will continue for VIIRS and the PEATE will demonstrate LAADS to the ST, the LDOPE (already a participant in the development of LAADS), and the NICSE to identify any additional requirements they may have for the system. It is expected that the system will be updated to meet such requirements within six months from the demonstration.

2.2 Implementation

This section explains how the functionality discussed in Section 2.1 will be utilized to support the ST, LDOPE, and the NICSE in the evaluation of the xDRs and the generation and testing of improved Land VIIRS algorithms. The system and processes described in the following sections are intended to describe those for the L-6 month Land PEATE system.

2.2.1 Computing Systems

Computing systems in the Land PEATE at L-6 months are shown in Figure 2.2.1 for the Land PEATE in Building 32 S-009. As shown in Figure 2.2.1, the following functions have dedicated resources:

- Development and configuration management – dual processor servers, nppdev and nppcm
- Testing – dual processor servers, minion 5046 through minion 5054
- Product Ingest and Job Scheduling – quad processor servers, LPEATE1 and LPEATE2
- Production of xDRs and DDRs – dual processor servers, minions 5055-5093
- Product Archive – dual processor servers, nstor2-nstor8, with 200TB of RAID disk
- Product Search, Order and Distribution – dual processor servers, LAADSweb1 and LAADSweb2
- LDOPE Q/A – dual processor servers, npp_landqa1 through npp_landqa3 and npp_landdb1

The Land PEATE systems will share a central network switch with the MODIS production facility, which facilitates the rapid delivery of MODIS products to the Land PEATE. Each computing system with the exception of the Ingest and Scheduling Systems in Figure 2.2.1will be a 2 processor server.

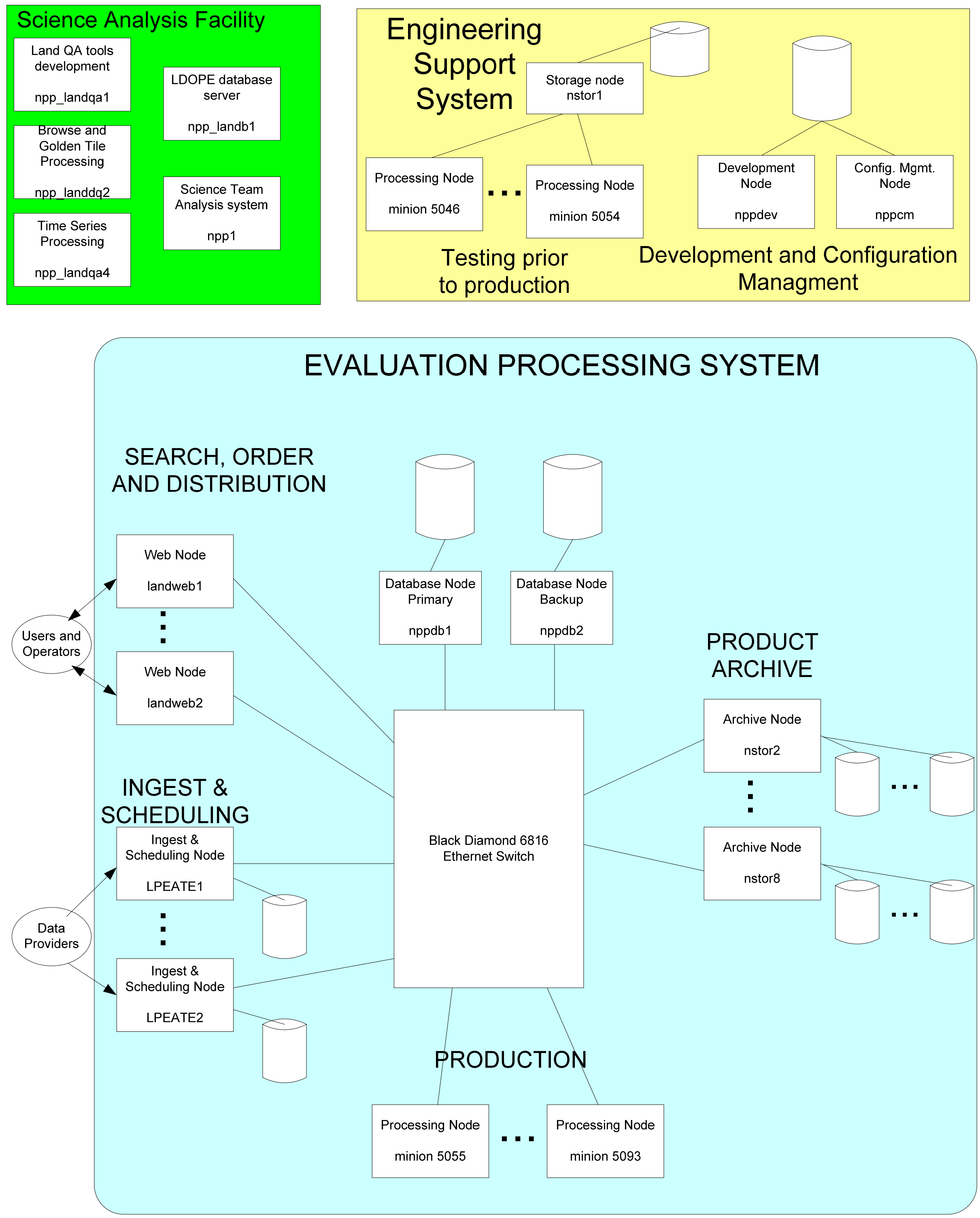

Figure 2.2.1 Land PEATE computers and storage at Launch – 6 months

2.2.2 PEATE Staff

The PEATE staff will perform the following tasks in support of the ST and the NICSE:

- xDR products generated by the IDPS will be acquired from the SD3E/CLASS, archived at the Land PEATE and, distributed to the ST and the NICSE to support their evaluations. All RDRs will be archived and EDRs and SDRs will be archived for 60 days as determined by the ST. PEATE staff will generate any xIPs that will be required for these evaluations and will be not available from the SD3E/CLASS.
- The Land PEATE will develop tools to support the xDR evaluation and will distribute these to the ST and the NICSE.
- VIIRS algorithms utilized at the IDPS will be acquired from CasaNOSA and will be integrated into the Land PEATE processing system, NPPDAPS, following unit testing. Tests using 8- or 16-day intervals will be conducted to establish that the Land PEATE and IDPS baselines will be in conformance.
- Requests from the ST and the NICSE to test modified versions of VIIRS algorithms will be processed. If necessary the Proxy Data Product Generator will be utilized to generate the inputs required to perform these tests and the required ancillary data products will be acquired from the data providers. The nature of the tests performed will be specified by the ST/NICSE and will range from small time intervals and VIIRS PGEs to large scale 16-day tests using multiple chains. The PEATE staff will work closely with the ST and the NICSE in order to ensure that these tests will be performed in a rapid manner. Test products will be made available to these groups through the LAADS. Land PEATE QA will be performed on these test products.
- Bugfixes to operational and improved science algorithms will be provided to the NPP Project Science Team (PST) for potential forwarding to the operational IDPS through CasaNOSA.
- The NPPDAPS and LAADS will be developed and maintained as the environment in which testing of improved science algorithms will be performed and data products will be distributed to the ST and the NICSE. Systems administration and database administration support will be provided to ensure the efficacy of these data systems.
- All versions of the Land VIIRS codes, those SDR and atmospheres codes used to provide inputs to land processing, and the NPPDAPS and LAADS will be maintained under configuration control.
- All Land PEATE activities will be documented in a central web site that will serve as a conduit for all users to Land PEATE services. The site will also provide a forum for information exchange within the user community.

The functional groups within the Land PEATE and their interfaces with the external elements discussed in Section 2.1.2 are illustrated in Figure 2.2.2. The Land PEATE will include the following six components:

- A Test group responsible for acquiring and archiving routine xDR, IP, and ancillary data products from the SD3E; acquiring and processing ad-hoc ancillary data required to support ST evaluations; acquiring any missing or corrupted xDR and IP data from CLASS; responding to requests from the NICSE or the ST for science products to support their evaluations; generating DDRs to support the NICSE and LDOPE evaluations; distributing all data products required by the NICSE, the LDOPE, and the ST, and; performing, as necessary, independent I&T on algorithms received by the Land PEATE.
- An LDOPE group responsible for QA activities for xDRs and any EDRs or SDRs generated by the Land PEATE in support of the NICSE or the ST.
- A Configuration Management (CM) group responsible for acquiring IDPS operational algorithms from CasaNOSA; providing algorithms and documentation to, or receiving from, the ST; delivering improved algorithm codes to the I&TSE for subsequent testing, and; maintaining

configuration control of all algorithms and documents acquired by or generated by the Land PEATE using the SVN system.

- A Software Development group responsible for unit testing all algorithms received by the Land PEATE and for integrating them into an NPPDAPS environment.
- A Systems Development group responsible for developing and maintaining the Evaluation Processing System and for ensuring that the hardware and software environment utilized by the Test, CM, and Software Development groups remains functional.
- A Documentation group responsible for generating systems documentation for the Evaluation Processing System and documentation of the algorithm production rules and dependencies.

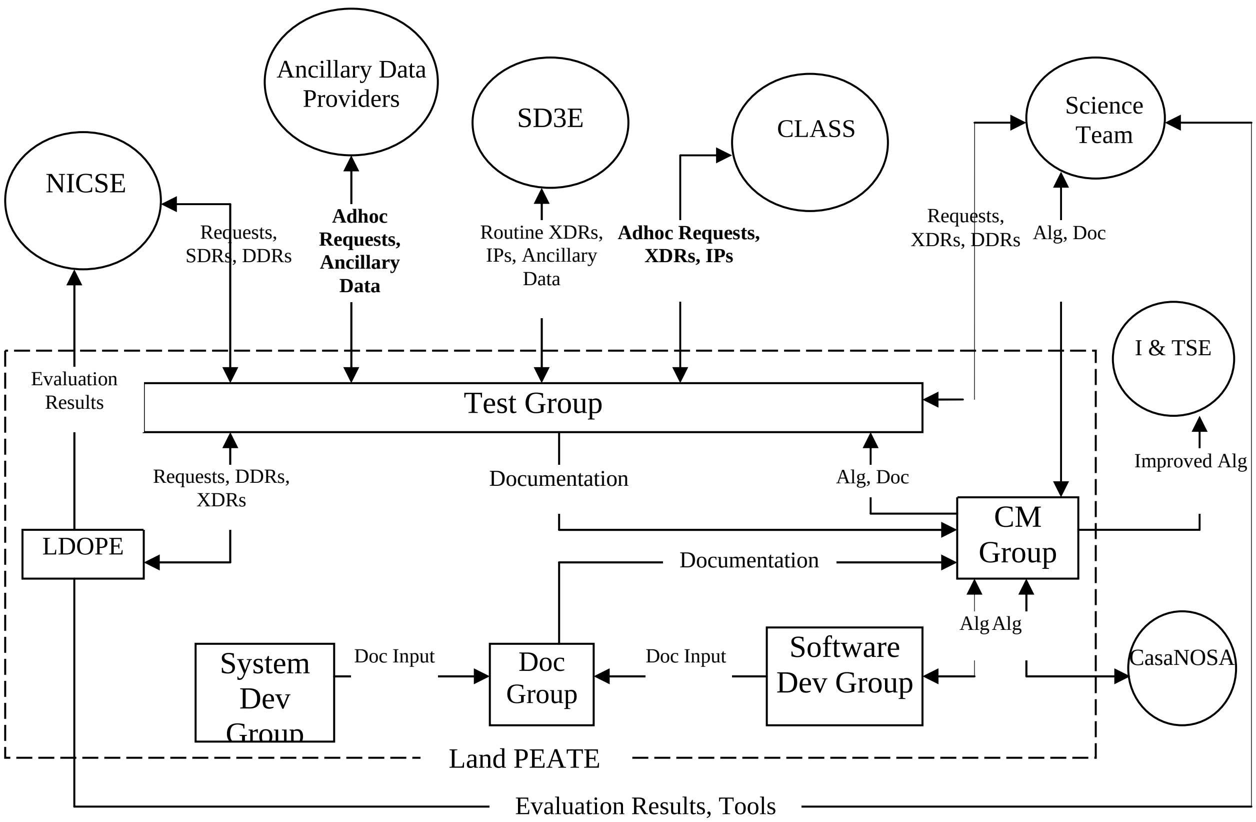

Figure 2.2.2 Land PEATE Functional Groups

PEATE staff will include the following:

- A Land PEATE Manager responsible for all PEATE activities and all planning and scheduling activities.
- A Configuration Manager responsible for maintaining all Land VIIRS code versions and NPPDAPS and LAADS under the proper configuration control. Configuration Management processes is described in Section 2.2.4.1.
- ASIs responsible for coding algorithms and algorithm improvements, unit testing VIIRS algorithms received from the CasaNOSA, the ST, and the NICSE, and for integrating these codes

into the NPPDAPS. Integration of NICSE codes is discussed in Section 2.2.3.1 and integration of CasaNOSA and ST codes is discussed in Section 2.2.4.2.

- A Test Manager is responsible for the archive and distribution of xDRs obtained from the IDPS, independent Integration and Test and for performing the science tests requested by the ST and the NICSE. The Test Manager will be supported by a Test Technician. These test processes are discussed in Section 2.2.4.3. These staff members will be also responsible for the Document Library (Section 2.2.4.4) and the Land PEATE website (Section 2.2.4.5).
- A QA Manager is responsible for QA of science test products and for the development of tools to support the xDR evaluations. The QA Manager will be supported by a QA Scientist and a Programmer/Analyst. The QA process is discussed in Section 2.2.3.2.
- A Systems Manager responsible for developing and maintaining the NPPDAPS and LAADS and the supporting hardware environment. The Systems Manager will be supported by Programmer/Analyst, Database Administration, and Systems Administration staff.

Additional details of the responsibilities of these staff members are included in the following sections. All of these staff members will be responsible for supporting the evolution of the present MODIS-oriented system to the L-6 months system that is discussed in Section 2.2.3, 2.2.4 and 2.2.5. This evolution is discussed in the Gap Analysis (Section 2.4).

2.2.3 Science Analysis Facility

2.2.3.1 Science and Calibration Teams

The interaction of the ST and NICSE with the Land PEATE includes the following tasks: subscription data ordering, data processing including DDRs and requested algorithm tests, data distribution, and revised code and LUT deliveries.

2.2.3.1.1 Subscription Data Ordering

The ST and NICSE will orders data from the Land PEATE that will assist in the assessment of EDRs and SDRs by requesting the Land PEATE to continuously send specific data (subscription request) from the Land PEATE to the requester via FTP push. The data will be sent to the member's facility to prevent the need for an operator to manually order and retrieve this data. The ST or NICSE member will request the Land PEATEs TM for subscription data. That request will include the following information: the required data (xDR, DDR), the requesters email address, the group (ST or NICSE) that is making the request, the FTP site where the data is to be pushed, and other constraints about the data such as a specific code version that produced the subscription data, specific geographical location, or the time period of the data. The data will be FTP pushed from the NPPDAPS processing system to the requesters FTP site. Notification by email will be generated by the NPPDAPS system and sent to the requester if the FTP push transfer cannot be successfully completed. The NPPDAPS system will try to re-send the requested files for 3 times with 6 hours separation between tries. When the FTP problem is resolved, the requester will contact the NPPDAPS operators with instruction to resend the needed data. The requester will be responsible to discover that new data has arrived at their respective FTP location and process the data accordingly.

2.2.3.1.2 Data Processing

The ST and NICSE will be able to request the Land PEATE to process various data including the following scenarios:

- The ST or NICSE requires the Land PEATE to run DDR products to assist in quality assurance of the downstream output products.
- The ST or NICSE requires xDRs output from a specific version of xDR code for analysis.
- The ST or NICSE requires the Land PEATE to run, at the ST or NICSEs request, tests on a set of input granules using an updated version of SDR, EDR or LUTs.

2.2.3.1.2.1 DDRs

The ST or NICSE will require the Land PEATE to run various DDRs in the NPPDAPS processing center to assist the ST and NICSE in their analysis of EDRs and the geolocation SDR. The output from these DDRs will be available to the ST or NICSE either by subscription as described in section 2.1.3.4.1, or in the LAADS archive as described in section 2.1.5.2. The ST and the NICSE is responsible for the upgrades and enhancements to the DDR algorithms. See section 2.2.3.1.3 for the details of delivering the DDR algorithm changes to the Land PEATE.

2.2.3.1.2.2 Specific Version xDR Code Output Tests

The ST or NICSE may be required to perform diagnostics on a given set of granules to look for a specific possible defect. This request needs a specific version of SDR or EDR code or LUTs to produce the anomaly. If the data required is not available in the LAADS interface, the ST or NICSE member will request the Land PEATE's TM to schedule a test run of the specified algorithms or LUTs to produce the needed output. The request will be sent to the TM by email and will include the following information: the email of the requester, the group the requester is associated with (ST or NICSE), the version of the code or LUTs that are needed to produce the correct output, and any constraints of the output products (time, geographic location, etc). Once the specific version of the algorithm and LUTs are run and output produced the Land PEATE TM will notify the requester through email that the data is available and either FTP push the data to the member's site, or make available the data on LAADS. The ST or NICSE will run their diagnostic routines and provides analysis on the given data.

2.2.3.1.2.3 ST or NICSE Request Updated Algorithm Testing

When the ST or NICSE deliver updated algorithms or LUTs to the Land PEATE, the Land PEATE will be required to run tests using the newly delivered algorithms or LUTs. The ST or NICSE member requesting the tests will email the Land PEATEs TM indicating the test that needs to be performed. This information includes the requesters email, the requester’s group (ST or NICSE), the algorithm or LUTs that were modified, and the input data that needs to be run through the testing procedure. The amount of test data generated by these tests can be large, so the TM and the ST or NICSE member must negotiate, if necessary, the logistics of storing and retrieving the requested test data. A test plan will be generated by the TM and will be published on the Land PEATE website. This plan will include test objectives, test schedule, algorithm versions to be executed, test time interval, and evaluation status (Section 2.2.4.3.3). The web site will be updated as a test passes from planned, to running, to complete. Each test will be assigned a test number that will be entered into SVN. The output from these tests will be stored in the LAADS interface and where the requester can access the data for their verification. The Land PEATE TM will work with the ST or NICSE member to determine when the results of the science testing procedure are no longer needed in LAADS and can be removed from the interface. For more information please reference section 2.1.4.3.3 on Science Testing.

2.2.3.1.3 Data Distribution

All xDRs, IPs, and ancillary data obtained from the SD3E and the DDRs generated by the Land PEATE will be archived in LAADS (See Section 2.1.5.2). It will be the responsibility of the TM to ensure that this process occurs successfully. Since all RDRs will be archived and only a subset of SDRs and EDRs will be archived, the former will be maintained on specific storage nodes within the LAADS disk farm and will be segregated from other products in order to expedite disk management. L-6.

The xDR and DDR products will be made available to the NICSE, the ST, and the LDOPE through the LAADS. The LAADS mechanism for distributing data will be used when the user asks the Land PEATE to process a specific data set, or only a few data granules are needed. Any xDR, IP, DDR, xIP, or ancillary products ingested into LAADS will be obtained directly by using the LAADS interface. Data searches will be be performed in LAADS or direct FTP access may be utilized. The user will initiate the data selection and distribution by making selections from the LAADS interface. If there is a product that is not currently available, the user may initiate the POD feature of the LAADS interface to acquire the needed data.

2.2.3.1.4 Revised Code and LUT Deliveries

When the ST or NICSE modifies xDR code or LUTs based on the analysis of current xDRs to improve the quality of the xDR code output, the ST or NICSE member will make the appropriate changes to the xDR code or LUTs, will run a simple unit test at the respective location, and will make the software package ready to be delivered to the Land PEATE for testing in accordance with the ST Software Delivery Guide. The ST or NICSE member will notify the Land PEATE CM via email, who will download the delivery package from the respective member's site to the Land PEATE and places it under SVN control. The Land PEATE ASI will build, test, and after the delivery is accepted, place the updated algorithm into the NPPDAPS processing system. The ASI will perform system tests on the updated algorithm or LUTs to ensure the NPPDAPS system can replicate the unit test data that were delivered with the updated algorithm or LUTs. If the ASI finds errors that are not correctable at the Land PEATE, the ASI will interface with the appropriate developer to resolve the problem. Once this resolution is verified by the ASI, the updated algorithm will be placed in the NPPDAPS processing system. The ST or NICSE member will schedule the needed science tests with the Land PEATE TM. This request will include the following information: the requesters email, the requesters group (ST or NICSE), the algorithm that needs to be run and the details of the input data. If the output data is to be FTP pushed to the requester’s site, the FPT directory will also be specified. The science tests will be run at the Land PEATE, and the TM will notify the ST or NICSE member when the tests are complete (See Section 2.2.4.3.3 for more details of the testing process). The ST or NICSE member will have access to the output data from the tests using the LAADS interface (section 2.2.2.5.2) or by subscription (section 2.2.2.1.1). The data will then downloaded to the requester’s site for further analysis. If these algorithm changes are demonstrated by the PEATES, ST, NICSE and the I&TSE, the modifications are submitted to the PSOE for their review and possible inclusion into the operational algorithms.

2.2.3.2 PEATE Quality Assurance

LDOPE has been the centralized QA facility for the MODIS Land Science Team since the launch of the EOS-Terra satellite. LDOPE will use its extensive experience assessing the quality of MODIS Land (MODLAND) products to sample and analyze the VIIRS Land xDRs. QA techniques, tools, applications and processes developed and used in analyzing the MODIS Land data products will be enhanced to support the NPP-VIIRS Land EDRs and other xDRs that may affect the quality of the Land EDRs

The QA functions will employee the following staff members:

- A QA Manager responsible for planning the day to day QA activity, interacting with the ST and the Science Test team about the product QA issues, algorithm updates, Science Test planning, ensuring proper functioning of the individual QA component procedures and identifying new QA requirements, procedures and techniques.
- A QA Scientist responsible for quality assessment of xDRs from the daily production and the Science Test. This person is also responsible for identifying problems in the products and source of the problem and identifying problems in QA procedures and tools.
- A Programmer/Analyst is responsible for design, development and maintenance of QA tools, procedures and all application software such as metadata database, time series analysis, browse, web pages etc.

2.2.3.2.1 QA Tools

LDOPE will use varieties of QA tools developed in house and other commercial-off-the-shelf tool (COTs) to help QA the VIIRS Land xDRs. QA tools will be broadly categorized into those involving data manipulation, data analysis and visualization tools. These tools are currently being used to QA the MODLAND products and will be enhanced to meet the NPP Land xDRs soon after the Land xDR formats have been finalized. These tools will be used to read or manipulate data values at both pixel level and file level. All QA tools will be developed in C, and will run at the UNIX command line. To help process set of similar xDRs, Perl scripts will be developed as wrapper to these tools. Some example command line tools are:

- enlarge/reduction tool: user can increase or reduce data set resolution
- metadata read: read the metadata in the file
- mosaic: create mosaic of one or more files
- read pixel: read pixel level data in all the files
- compute stat: compute summary statistics of data in file
- read attribute: read data attributes

LDOPE will develop generic QA tools and provide these to the SCFs where appropriate. Product specific QA tools will be developed by the individual SCF. However, LDOPE may also develop product specific QA tools with guidance from the SCF or may directly acquire the tool developed by the SCF. Product specific QA tools available at the LDOPE will also be distributed to all the SCFs. The QA tool software package will be distributed from the LDOPE web site. The LDOPE QA tools software package will include the source code, executables, installation instruction and a user manual. A pre-launch version of the software package will be available 6-months prior to launch. Revised versions of the software will be released in stages as required.

2.2.3.2.2 Metadata Database

LDOPE will create a metadata database which can store metadata of all the Land xDRs and IPs produced at the IDPS and the Land PEATE. LDOPE will parse these QA logs (QALDR) to extract the metadata and will ingest the metadata to the metadata database. LDOPE will develop a web based query system that can support user queries for text and graphic display of useful metadata such as PGE versions, quality of the xDRs, production date time etc. A graphical display of metadata will be used to visualize the file level quality related information on a global scale.

2.2.3.2.3 Global and Golden Tile Browse

Global browse images will be created using the coarse spatial resolution products (CRBDR) by projecting data into a global coordinate system defined with pixel sizes corresponding to 20km in the Hammer-Aitoff projection. These global browse images will be generated with fixed contrast stretching and color look-up tables to enable consistent temporal comparison. A web interface will be developed to support interactive selection of browse and zooming and panning at 5km resolution. This will enable synoptic quality assessment of Land EDRs via the internet. The global browse image will be linked to the metadata database to identify the xDRs that fall within the selected geographic area. LDOPE personnel can then connect to LAADS to order these data for further analysis. Figure 2.2.3 shows the sample LDOPE sample global browse of MOD09 product from the MODLAND QA. Full spatial resolution browse images for a number of fixed globally distributed locations, called the Golden Tiles, will also be made available at select locations.

2.2.3.2.4 Time Series Analysis

A time series of summary statistics derived from the Land xDRs Golden Tiles (GTSDR) will be maintained and monitored by LDOPE personnel in order to enable synoptic quality assessment via the internet. Product time series analyses will be important because they capture algorithm sensitivity to surface (e.g., vegetation phenology), atmospheric (e.g., aerosol loading) and remote sensing (e.g., sun-surface-sensor geometry) conditions that change temporally, and because they allow changes in the instrument characteristics and calibration to be examined.

GTSDRs obtained from the Land PEATE will be parsed and the time series statistics data will be ingested into the time series statistics database. Time series plots will be generated from these statistics data and will be posted on a web. Though a visual inspection of time series plot can reveal obvious outlier in the time series, a more careful analysis may be required to identify all the outliers. Hence manual detection of outliers is a very difficult and time consuming task. An analysis system will be developed to analyze long time series statistics to detect outliers in the time series data. Original xDRs and IPs corresponding to the outlier data will be investigated in detail by LDOPE personnel. Time series system will also be used to compare multi-year data and also multi-instrument data e.g. comparison of NPP and MODIS data, and NPP and AVHRR data.
Figure 2.2.4 shows the sample time series plot of dataset from MOD09A1 for tile h20v11 from the MODLAND Golden Tile Time Series Analysis.

2.2.3.2.5 Animation of Global Browses

Animations provide an effective way to illustrate the functioning of the Land xDR algorithms and to assess quality of the xDRs. Animations of year-long browses of selected Land EDRs will be created in gif and jpg format and will be made accessible via the Internet.

2.2.3.2.6 LDOPE QA web page

LDOPE will develop and maintain a web page containing information on the on-going QA activities and the results of QA analysis conducted at LDOPE. A web site similar to the one developed for MODLAND QA (http://landweb.nascom.nasa.gov/cgi-bin/QA_WWW/newPage.cgi) will be developed for NPP Land Data Quality Assurance and will contain menus linking the results of all the activities described above.

LDOPE will post summary of quality related problems in Land xDRs as QA issues on a known issues page. Issues for each Land xDR will be posted on a separate page. A background coloring scheme will be used to identify different status (pending, closed, note and reopened) of the QA issues. Figure 2.2.5 shows a detailed description of a known issue from the list of issues of MOD09.

The LDOPE QA web page will be accessible through the Land PEATE web site.

2.2.3.2.7 QA for Science Tests

LDOPE will duplicate all of the above tasks to support QA of the data from the science tests used to support the evaluations of enhanced algorithms. Browses and time series systems will be developed for both the baseline and the test versions of the data. LDOPE will compare the test version of the data to the baseline version to validate the algorithm changes. Separate web pages and database will be maintained for the Science Test evaluation.

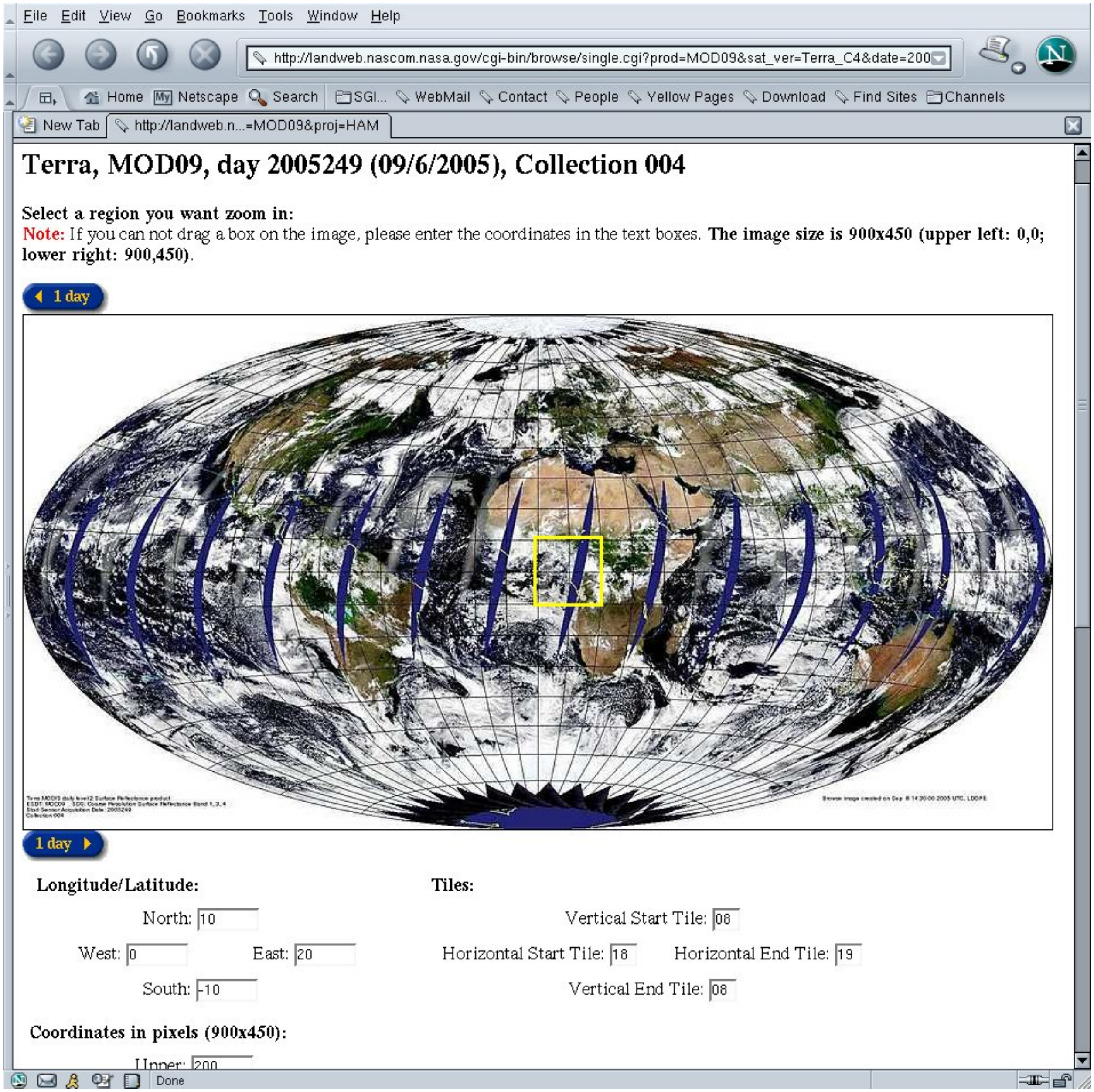

Figure 2.2.3 Sample LDOPE Global Browse for MOD09

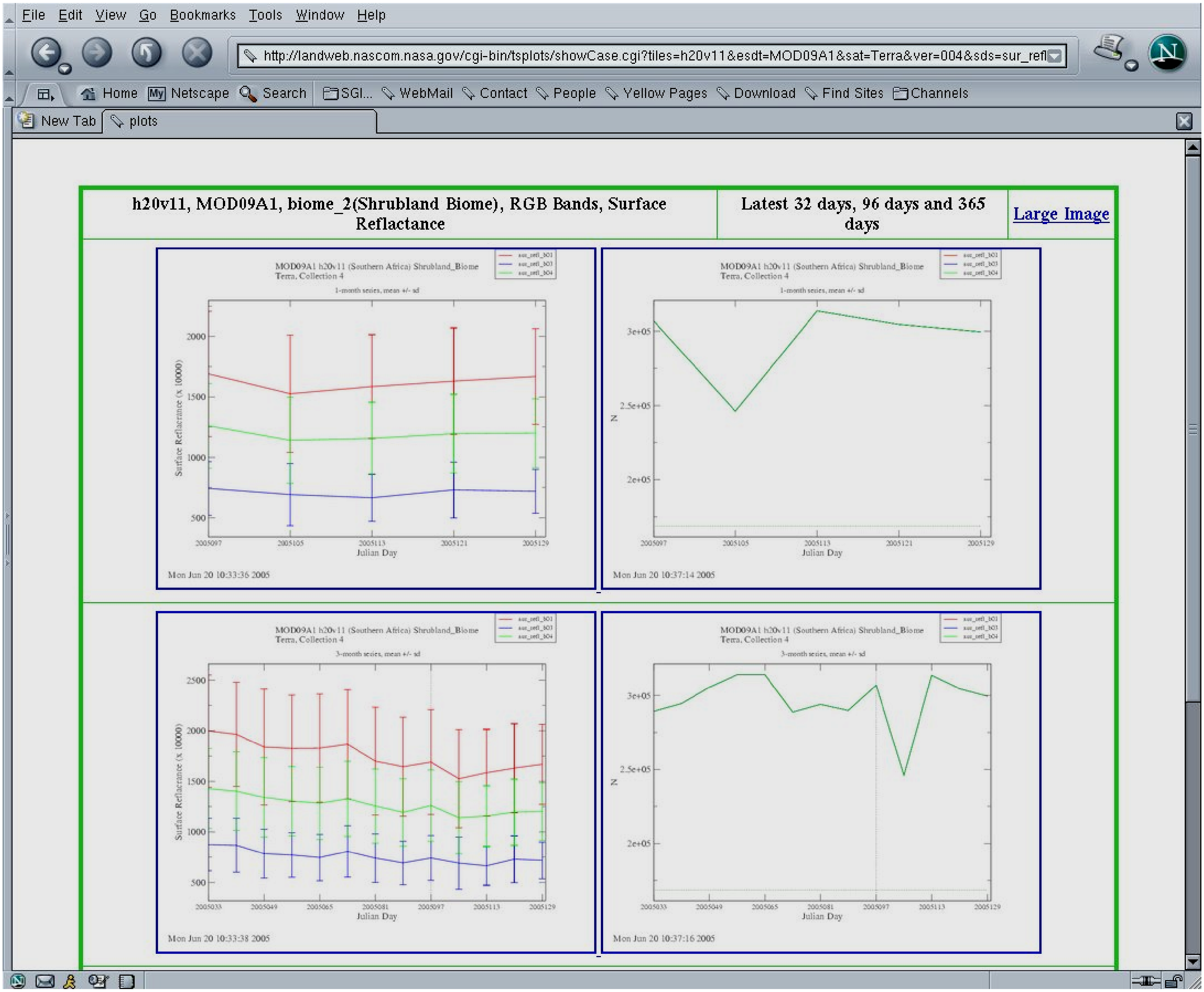

Figure 2.2.4 Golden Tile Time Series Plot of MOD09A1 from Tile h20v11

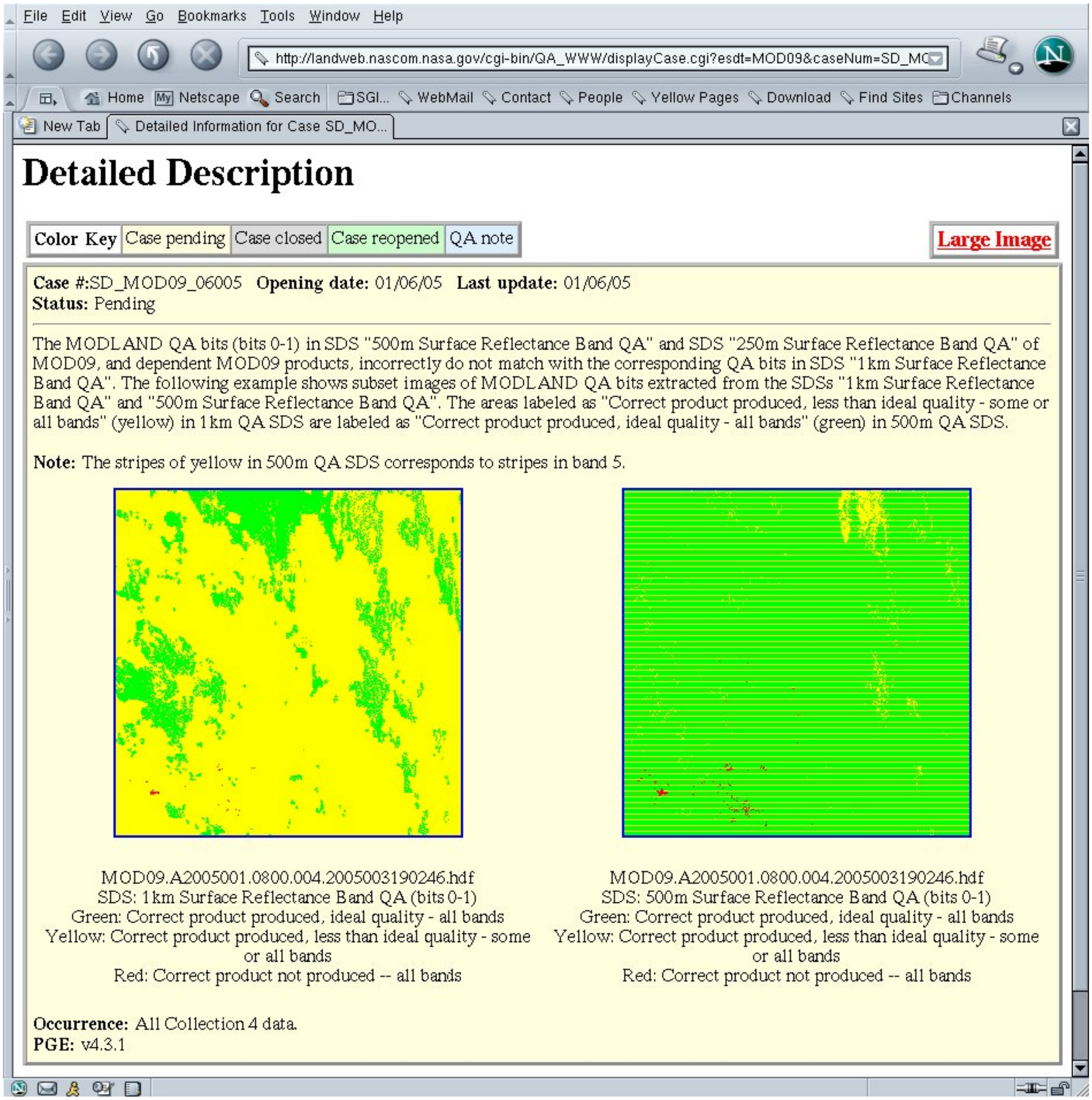

Figure 2.2.5 LDOPE Web Page Known Issues

2.2.4 Engineering Support System

The Engineering Support System is the internal Land PEATE infrastructure support for meeting the requirements of the ST and the NICSE. The functionality associated with this infrastructure has been described in Section 2.1.4. The following sections discuss implementation of the Configuration Management process, the Software Development process for assimilating algorithm codes into the NPPDAPS, the Science Test process to support algorithm and xDR evaluations, and the Document Library and the Land PEATE Web Site.

2.2.4.1 Configuration Management

The Land PEATE CM manager's responsibilities will be to:

- Receive and/or retrieve all algorithms, source codes and associated test data from external sources, such as CasaNOSA, SD3E, NICSE, and ST.
- Receive integrated algorithms software, i.e. PGEs, from Land PEATE Algorithm Software Integrators (Section 2.2.3.2).
- Baseline and version-control all source codes and documents in SVN.
- Baseline static data, such as LUTs, coefficient files outside of SVN.
- Assign and document ArchiveSets for all dynamic test data.
- Ingest the data into NPPDAPS.
- Deliver algorithms and source codes to external users .
- Build the source code into NPPDAPS.

The Land PEATE Software Master Library will store documents, software and scripts used in setting up the build environment and in compiling the code. These groups of configuration items (CIs) will be stored in SVN. All CIs will be versioned using the schemes described in the below section.

2.2.4.1.1 Land PEATE Versioning Scheme

The Land PEATE will use a four-part version scheme to identify the version of the PGE containing the algorithm code. An example of this A.B.C.D format is given below:

> A: PGE Type (C= SCI code, P=OPS Code, D=DDR Code, CMG Code, or Coarse Resolution Product Code)
> B: PEATE build number
> C: Algorithm increment (if one or more processes or PGE components contain an algorithm change
> D: System increment (if one or more processes or PGE components contain a system change

SVN has its own internal versioning scheme called a revision. The revision number is incremental and it is automatically assigned with each checkin/commit to the SVN and it applies to the whole repository. The revision number can be used to describe and recreate the state of the repository at any point in time. SVN users will use these revision numbers as a means of tracking changes to code committed to repository, even if the code changes are not yet final. When final code changes are ready to be turned over from the ST to the Land PEATE or from the Land PEATE to CM, the SVN revision number will be used to identify the changeset.

Following the successful MODIS practice, PGEs will be grouped together into “recipes” for processing efficiency in NPPDAPS. Recipes will be version controlled by CM. Since Recipes are defined internally in the Land PEATE, only three fields will be used for Recipe versions, instead of the four fields used for PGEs. Starting from left to right, the first field will reflect the science algorithm update at pre-launch/launch periods using 1=pre-launch and 2=post-launch. The second field will be for special purpose processing, for example, reprocessing. The third field will be an incremental number for a specific combination of PGE versions running in NPPDAPS.

The versioning scheme for in-house developed and third party utilities code will consist of three-parts. Using SDP toolkit version 5.2.10 as an example, starting from left to right, the first part will indicate major changes to the software such as new functionality and features, the second part will reflect changes that a somewhat significant, and the third part will indicate minor changes to the release. In most cases, the version number assigned to third party utilities will be the same version number used by the vendor.

The Land PEATE document versioning scheme will have 2 components, for example, NPP_001_V1.0, NPP_001_V1.1, etc. Starting from left to right to left, the first component will refer to major changes in the document, and the second component will indicate minor changes to the document.

The Land PEATE will generate and distribute a detailed white paper to document the versioning technique that will be used in NPPDAPS.

2.2.4.1.2 Documents and Software

Documents, software and related items will be kept in the SVN repository. The Land PEATE algorithm code (including DDR algorithms) will have an SVN directory tree similar to the PGE structure currently used in MODIS and will reside on the main line (/trunk) of the SVN repository. The Land PEATE ASIs will have a set of rules for constructing low-level directories. Application of these rules ensures that the development's CI directories will merge into the existing Software Master Library structure and are therefore consistent with other CI directories. These rules are provided during the initial software development phase.

The repository directory structure for code ingested will be similar to that on CasaNOSA, ST, and NICSE systems. All code and documents deliveries from these external sources will be ported to their respective branch (storage area) of the SVN repository.

Only finished documents will be committed to the SVN repository. CM will assign a document number with a prefix of NPP, followed by a 3-digit for project documents such as the System Description Document, example NPP_002. Test documents will be stored in a subdirectory under doc/testing and will be further broken-down by specific test types, for example, I&T) or Science. All documentation related to a specific test will be stored in a directory with naming derived from the versioning scheme described in Section 2.2.3.3.3.1, Versioning Science Tests. For example, Science Test 1.0.0.0 would have test plans, test report and test results stored at:

$SVN/NPP/docs/testing/Science/NPP_test1.0.0.0

In-house and third party utilities used by the project, and scripts developed for in-house use will be stored in a separate repository. Compiled and baselined versions of project utilities and copies of project scripts will be staged in a directory outside the SVN repository with read-only privileges for easy access by users.

Figure 2.2.6 is an example of the Land PEATE configuration management directory structure. All source code, scripts and documentation together with test plans, test reports, and test results will be housed in the SVN repository. SVN tags/labels using the algorithm code or document versioning scheme will be created and applied to mark formal baselines. All non-SVN managed files such as LUTs and large test input data files will be stored in a CM controlled repository outside SVN. Non-SVN top-level directory names will reflect the data’s source of origin along with the version number.

SVN Repository **Non_SVN Repository**

```
$SVN/NPP/
    OPS
      --- PGE301
      ---PGE302
     ---branches
       ---CasaNOSA ( IDPS --external code)
          ---SDR
             ---geolocation
                ---doc
                ---include
                ---src
    ----docs
          ---NPP_001 (Software Design Docment
          ---NPP_002 (System Description Document)
          ---Testing
               ---Science
                    ---NPP_Test1.0.0.0
                         ---test plans
                         ---test report
                         ---test_results
     ---tags (mark formal baselines)
       ---Drop1.3.0_VIIRS (Tag applied to IDPS code)
       ---NPP_V1.3.0.1.1 (Tag applied to land PEATE baselined code)
       ---NPP_001_V1.0
       ---NPP_002_V1.0
```

```
$CM/NPP/
     ---Drop1.3.0_VIIRS
          ---TestData
       ---coeff
          ---NPP_OPS
          ---NPP_SCI
          ---NPP_ST
```

Figure 2.2.6 LPEATE Repository Structure

2.2.4.1.3 Software Ingest and Transmittal Processes

The Land PEATE CM Team is responsible for ingesting code, look-up tables, and test data from the CasaNOSA, ST and NICSE systems; compiling the code delivered by the Land PEATE ASI, and creating formal baselines. A site configuration package containing code modifications and accompanying documentation will be created and transmitted to the CasaNOSA system.

2.2.4.1.3.1 Code Ingest

The MODIS integration system currently uses the ClearCase configuration management utility to store and version science code. In this environment, ClearCase scripts are used to ingest, version, and label science code and associated documents such as code change histories, build instructions, and production rules. Based on this experience we will use the open-source versioning utility, SVN. Many of the concepts used ClearCase will remain valid for SVN. For instance, C-shell scripts are utilized to compare code deliveries with baselined code to check for changes. These mechanisms will be ported to a system that uses Subversion configuration. Using modified mechanisms that we have in place for MODIS, CasaNOSA and NICSE code changes will be autonomously checked for validity. In addition we will use modified scripting techniques to ingest and version CasaNOSA and NICSE code deliveries into the SVN system.

2.2.4.1.3.2 Software Build

The Land PEATE ASIs will deliver algorithm code to CM for baselining via a delivery mechanism similar to that current used for MODIS. Once ASI is ready to turnover code to CM, a script is run. The ASI delivery script will commit/checkin the code to the SVN repository, note the automatic internal SVN revision number and notify CM that a code delivery was made.

The CM Team will pull/copy the SVN code revision number identified in the ASI delivery notice and performs an application software build. The build is composed of two processes: the software build process and the build verification process. The build process includes code compilation, linking, and other activities required to produce executables files. The build verification process includes the activities required to demonstrate that the software build produced by CM is equivalent to that produced by ASI.
The software builds will be performed using CM developed build scripts. These scripts will be created using instructions provided by ASI in a delivered ‘readme’ file. The build scripts also sets any environment variables needed to compile the code. The use of build scripts ensures that the compile environment is always the same regardless of the team member performing the build and that code rebuilds will have the same integrity and reliability as the original build.

The Land PEATE CM will compare the software build results with that produced by ASI. Criteria such as name and number of files generated, and size of executables will be considered. If the build succeeds, CM will lock the tag/label attached to the pieces of code so that the specific baseline will easily be identified. The Land PEATE CM-generated executables along with any necessary files needed to run in NPPDAPS will be installed to a predefined staging area.

2.2.4.1.3.3 Software Baseline Promotion

The baseline promotion process includes the installation of the builds generated from a specific Land PEATE baseline into the I&T and/or Science Testing environments. Upon request by I&T or Operations, CM will promote a LAND PEATE baseline to that environment. Initially, the CM Team will maintain baselines for:

- Deliveries from external sources such as CasaNOSA, ST, or NICSE;
- PGEs versions passing through I&T and/or Science Testing environments;
- Staged versions of utilities used by the Land PEATE;
- Deliveries of the Land PEATE algorithm code to CasaNOSA;

- Published Land PEATE documents.

2.2.4.1.3.4 Site Configuration Packaging and Delivery Process

The site configuration packaging and delivery for CasaNOSA will follow a similar process previously used by MODIS CM for code deliveries to the Goddard Earth Sciences Distributed Active Archive Center (GES DAAC). The CM Team will build target system-specific site configuration packages for transmittal to the CasaNOSA system. The types of files contained in the site configuration package include source code, documentation, and any necessary scripts such as run scripts. Land PEATE CM will transmit the site configuration package to a pre-designated area on the CasaNOSA system, and send notification as requested via email.

2.2.4.2 Software Development

The approach to be used for the VIIRS Land algorithm enhancement and data quality evaluation in Land PEATE will be primarily based on methodologies used in the current, proved MODIS system, with necessary enhancements on existing software utilities and development of new ones to facilitate and lessen labor-intensive nature of the integration process. This section will discuss the major steps in the Land PEATE algorithm software development. Implementation of the Software Development functions will utilize the Configuration Manager (Section 2.2.4.1) and the ASIs. The ASIs will be responsible for unit-testing and integrating source codes from external sources into PGEs that can be processed in NPPDAPS. ASIs will first receive source codes from CM and then build code in integration area with necessary configuration changes and operational code wrapper integration, and perform unit tests to replicate the test output of the source code.   Then ASIs will integrate the source code into PGEs, perform integration tests and verify the test output. Successfully integrated and tested PGEs will be delivered by ASIs to CM for baseline.

2.2.4.2.1 VIIRS Code and Data Ingest

NPPDAPS integration system will use the SVN configuration management utility to store and version VIIRS operational code from the CasaNOSA, VIIRS code from the ST, and VIIRS calibration code from NICSE that will be used in processing the science data in the Land PEATE. In the SVN environment, separate branches will be used to ingest, and version the operational, science, and calibration code and associated documents such as code change histories, build instructions, and production rules (see 2.2.4.1.3). In addition C-shell scripts will be utilized to compare code deliveries with baselined code to check for changes. Using this mechanism, code changes will be checked for validity.

NPPDAPS will utilize external interfaces to regularly ingest xDRs, IPs, calibration products and ancillary data from SD3E, to make ad-hoc data requests for and ingest xDRs and IPs from CLASS, calibration data from NICSE, ancillary data from CLASS, and engineering data from the Command, Control, and Communications Segment (C3S). NPPDAPS will also ingest pre-launch algorithms and test data from the CasaNOSA, that also use Subversion CM utilities. NPPDAPS will use cksum to perform a basic level of validation on all acquired data to determine that the data files received matches the data files that will be expected.

For each baselined version of code, a specific ArchiveSet will be used to ingest the associated input and output data into the NPPDAPS system. Any data with one ArchiveSet can be cloned to a data with another ArchiveSet, so different version code may share with same input data.

2.2.4.2.2 Software Integration in NPPDAPS

Each operational, science, or calibration code will be integrated and packaged into PGEs that include PGE script, production rules, LoaderModules, operational code wrappers (see 2.2.4.2.5), executable build instructions, code change history, platform environment, packing list, configuration list file, etc. Configuration list files (or ciLists) will specify the version numbers of the PGE code and the associated libraries, included directories, and documentation. Production rules documentation will specify rules and inputs used by the PGE. Build instructions will be produced in conjunction with developers to provide pertinent information on the creation of executables.

During the integration, several utilities will be employed to check the validity of the software with regard to programming standards. The forchk utility will be used to check for code conformance for FORTRAN code. For C code the Makefile flags: "-ansi -fullwarn", can be used to provide a similar verification. For C++ the "-Weffc++" flag is applicable.

Each code makefile will be modified and tailored to fit into the NPPDAPS environment. These modifications will often be handled via build scripts that point to appropriate libraries and include file areas. NPPDAPS will use a recursive makefile that is compatible with GNU ("GNU not UNIX") and MIPS make. Often, for early code development and testing the debug option is set in the Makefile. This involves the use of no code optimization along with setting the debug flag. The executable can then be run through the Unix debug utility, dbx to check code paths and variable values.

2.2.4.2.3 Unit and Integrated Tests

Unit tests will run using test data provided by science/calibration code developers for science/calibration code, or using xDRs and ancillary data ingested from CLASS for the operational code. The purpose of the unit and integration tests will be to replicate the test output data. The tests will be driven by the PGE scripts which will be developed in-house, and a Process Control File (PCF) which lists all the input and output data, and the runtime parameters. Command line tests that exercise only the PGE script will be run in a Linux environment. The integration test inside the NPPDAPS system that exercise both the loader and PGE scripts will also be run in a Linux environment. The DpPrRusage will be used during the integration tests to check for system utilization, including elapsed run times and memory utilization.

2.2.4.2.4 Test Data Validation

Following a successful code test run, C-shell scripts will be used to evaluate the PCF file. Additional scripts (C-shell and Perl) and Interactive Data Language (IDL) routines will be used to verify the outputs by quantitatively and visually comparing the outputs with those provided by the developers or retrieved from the SD3E. If large differences are identified between the Land PEATE output and the developer test output, the developers will be notified to assist in tracking the reasons for the discrepancies.

Several other utilities will be employed in the output verification step. The *hdiff* utility provides a quick verification of the Land PEATE test output with regard to the developers test output. In addition, IDL scripts and visualization tools will also be used to validate the output. The *writefilespec* utility will be employed to check the validity of the test output data with regard to HDF structure. This utility provides a listing of the HDF metadata and Vgroup data attributes to be compared with the baselined file specifications. Differences in the test and developer output, or output HDF anomalies may be a result of memory problems caused by such problems as improperly indexed arrays.

2.2.4.2.5 Toolkit for Operational Code I/O

The operational code running in the IDPS will be implemented in the IPO (Input-Processing-Output) mode, which means that in the operational algorithms the retrieval of input data and storing of output data will be performed separately from the processing of the data. An input needed by or an output produced by an operational algorithm will be represented by a data item that contains metadata describing the data, a pointer to the location of the input or output data buffer, and methods for retrieving data from or storing data to the proper location. Consequently, operational code at the IDPS will not directly read input files and write output files as science code does, but instead, both input and output data will be accessed through memory buffers in the Data Management Subsystem (DMS).

In order to run operational code to process science data in NPPDAPS, a library of routines will need to be developed to handle input and output from HDF 5 files rather than memory structures. This library will be used in the integration of all VIIRS Land PGEs.

2.2.4.2.6 Bug Management

The Land PEATE will use Bugzilla, an open source, web-based, Bug-Tracking System, for documenting and tracking outstanding software bugs. Bugzilla will be used to track bugs and code changes, improve communications, submit and review software patches, and manage quality assurance. Access to Bugzilla will be provided through the Land PEATE web site.

2.2.4.3 Testing

Land PEATE testing incorporates a number of functions pertaining to the archive and distribution of xDRs obtained from the SD3E, the generation of DDRs to support xDR evaluations by the NICSE, the ST, and the LDOPE, the integration of PGEs into the NPPDAPS, the generation of test data sets for evaluation by the ST and the NICSE, and these functions are described in the following sections.

The functions associated with supporting xDR evaluations by the LDOPE, NICSE and the ST have been discussed in Section 2.1.3. Section 2.2.4.3.1 discusses the implementation of these functions.

With respect to the integration of PGE codes into NPPDAPS, the initial unit test process performed upon receipt of the PGEs from CasaNOSA or the NICSE and the ST has been described in Section 2.2.3.2. Following this the codes will be subjected to independent I&T. This test is a system-level test intended to establish the viability of the algorithm codes within the NPPDAPS system and is described in Section 2.2.3.3.2. The final test stage is science testing in which combinations of PGEs will be executed in order to generate xDR products for evaluation by the ST and the NICSE. This function is described in Section 2.2.3.3.3. Both the XDRs received from the IDPS production activities and those generated by the Land PEATE science tests will be subjected to Quality Assurance the results of which will be presented to the ST and the NICSE to support the xDR and PGE evaluations. The QA function has been described in Section 2.2.2.2 The support hardware for these functions is illustrated in Figure 2.2.4. The I&T and Science Test functions will employ the following staff members:

- A Test Manager (TM) responsible for archiving and distributing xDRs obtained from the SD3E and CLASS, I&T and Science Test planning, interacting with the ST and the NICSE to identify science test requirements, ensuring the timely execution of all related tests, maintaining the test-related sections of the web site, maintaining and tracking the test-related deficiency items in Bugzilla, ensuring the orderly transfer of science data products into LAADS, establishing SVN flags when I&T has successfully completed, and establishing passwords if required.

- A Test Technician (TT) responsible for the acquisition of ancillary data products, performing I&T and generating test reports, utilizing the proxy generator on an as-needed basis, executing science test plans including acquiring appropriate algorithm versions from SVN, reconciling data transfers to LAADS, executing any processing-on-demand requests in LAADS, maintaining the LAADS and Evaluating Processing System disks, providing user support services, and maintaining LAADS passwords.

The approach taken for all components of the Land PEATE Testing and QA will be based upon several years of successful experience with Aqua and Terra MODIS data products. To the extent possible the tools developed during this work will be utilized for the Land PEATE activity.

2.2.4.3.1 xDR Archival and Evaluation Support

All xDRs products, including the IDPS produced xDR data and any DDRs generated by the Land PEATE to support the xDR evaluations will be ingested into the NPPDAPS and archived by the Land PEATE in the LAADS. This process will be the responsibility of the TM. RDRs (and associated DDRs) will be archived for the duration of the mission but the EDRs and SDRs will be limited to a 60-day rolling archive the precise content of which will be determined by the Land PEATE in conjunction with the NICSE and ST requirements. The TM will be responsible for ensuring that this archive is properly maintained. The TM will also be responsible for replacing any corrupt data in the archive and acquiring any data xDR products required by the ST or NICSE which will no longer be available from the SD3E or the Land PEATE archive. This will be done by submitting requests to CLASS. It is assumed that the availability of this category of products from CLASS will be limited to small numbers of granules.

The operational IDPS algorithms will be obtained from the CasaNOSA by the Configuration Manager and will be integrated into the NPPDAPS by the ASIs (Section 2.2.4.1.3). The TM will conduct tests using these PGEs and the RDRs and ancillary data obtained from the SD3E to establish that the NPPDAPS system is able to replicate the SDRs and EDRs obtained from the SD3E. The results of these tests will be reviewed by the NICSE, the ST, and the LDOPE. These tests will establish the NPPDAPS codes from CasaNOSA can be successfully utilized to generate substantial volumes of baseline products for xDR products no longer available from the Land PEATE or the SD3E. These baseline products will support both xDR evaluations and the science tests discussed in Section 2.2.4.3.3.

The TM will generate DDRs as required by the NICSE and the LDOPE to support xDR evaluation. The NICSE and LODPE requirements have been described in Sections 2.2.3.1 and 2.2.3.2. These DDRs will be generated by NPPDAPS for all RDRs obtained from the SD3E. The Land PEATE will generate xIPs to support xDR evaluation upon request from the NICSE and or ST.

2.2.4.3.1.1 NPPDAPS Data Ingest

In order to ingest xDRs and DDRs into NPPDAPS and LAADS, each xDR or DDR will have an Earth Science Data Type (ESDT) that will contain NPOESS Data Product ID. When xDRs and DDRs will be archived in NPPDAPS and LAADS, each data set will have a unique ArchiveSet flag. Both NPPDAPS and LAADS will be configured so that when xDRs/DDRs will be archived in

NPPDAPS, the data will be nearly instantly transferred into LAADS. The metadata information of the data will copied from NPPDAPS database to LAADS database by DBsync tool.

Although the complete xDR/DDR metadata definitions have not been determined at this time, some searchable metadata, such as Day/Night flag, Orbit number, Bounding Coordinates, granule/grid StartTime, and some QA metadata, will be stored into database when a xDR/DDR data is archived. The metadata will be useful when users search and order VIIRS data from LAADS.

2.2.4.3.2 Integration and Test

Whereas unit testing by the ASI will be performed on a single PGE using a few granules of data and will replicate test results provided with the PGE, I&T will utilize several hours of input data and will evaluate several aspects of the PGE performance within the NPPDAPS by executing standardized, “black-box”, system-level tests. I&T will maintain a series of “golden datasets” that will provide the inputs for all of the PGEs to be maintained by the Land PEATE. These datasets will be maintained in SVN. Although I&T will generally be performed on a single PGE, limited chain tests will be performed if necessary to test the downstream affects of PGE changes. It is intended that the I&T process will be rapid-response in nature and that performing, evaluating, and documenting the test results will take less than 2 working days per PGE.

The TT will be responsible for executing the I&T tests defined by the TM. The TT will obtain the required PGE version and golden datasets from SVN,will monitor the test progress and will perform the following checks on the test results to ensure that:

- All basic information concerning the processing run is entered correctly into the NPPDAPS database including data start and end times for the processing run and the number of PGE recipe instances in the RunOK, NoRun, and RunErr state.
- All test products have been ingested correctly in the NPPDAPS database and exist on the production disk including that:
  - Files have been ingested into the correct NPPDAPS tables
  - Files exist on correct archive tree
  - The correct number of output files were generated
  - The output files have the correct file names
- The output files have the expected size
- All expected PGE and NPPDAPS LogFiles were created and that they contain no error messages that indicate severe problems including that:
  - The correct numbers and types of logfiles were created
  - Exit codes equal 0
  - No “F” (fatal error) messages exist in the logfiles
  - No “E” (Error) or “W” (warning) messages will be in the logfiles that may require review by the ASI
- All metadata fields in the test products have been filled correctly
- Any known or previously identified problems with the software have been fixed

The TT will inform the TM, the ASI, and the CM if the test is “pass” or “fail” and will document the test results in a test report that will be maintained in the SVN system. Based upon the MODIS experience, approximately 5% of the I&T tests have failed. The TT will use a pre-defined template for the report. In addition to the above listed items, the report will document the PGE performance in terms of the wall clock time and the cpu utilization. The TT will inter-compare these results with available data from earlier PGE tests and will inform the TM and the ASI of any significant changes.

Any problems uncovered in testing will be recorded in the Bugzilla system. The TT will work directly with the ASI to resolve problems.

At the discretion of the TM, some PGE updates will bypass I&T depending upon the nature of the following science tests. As discussed in the following section some science tests will involve very limited time periods of order one day and possible one or two PGEs. In this event there will be no separate I&T testing and the science test will also be used to perform the I&T analysis and reporting process. However, many science tests will involve multiple days and PGEs and in this event separate I&T tests will be performed before the science test is executed.

The I&T effort will also include testing of new versions of NPPDAPS or LAADS. This testing will range from testing a new system feature for minor system updates to acceptance testing for a large release. In general, this testing will be performed by the TM who will document the results and deliver them to the systems development staff. All errors and deviations will be reported in Bugzilla.

2.2.4.3.3 Science Testing

The science test process will generate data sets to support the NICSE staff and the ST members in their evaluation of xDRs and their generation of new, and potentially improved, versions of the science algorithms. It is the objective of the science test process to be able to respond rapidly to requests from the ST/NICSE. Three distinct steps will be taken in the science test process are summarized in Figure 2.2.8.

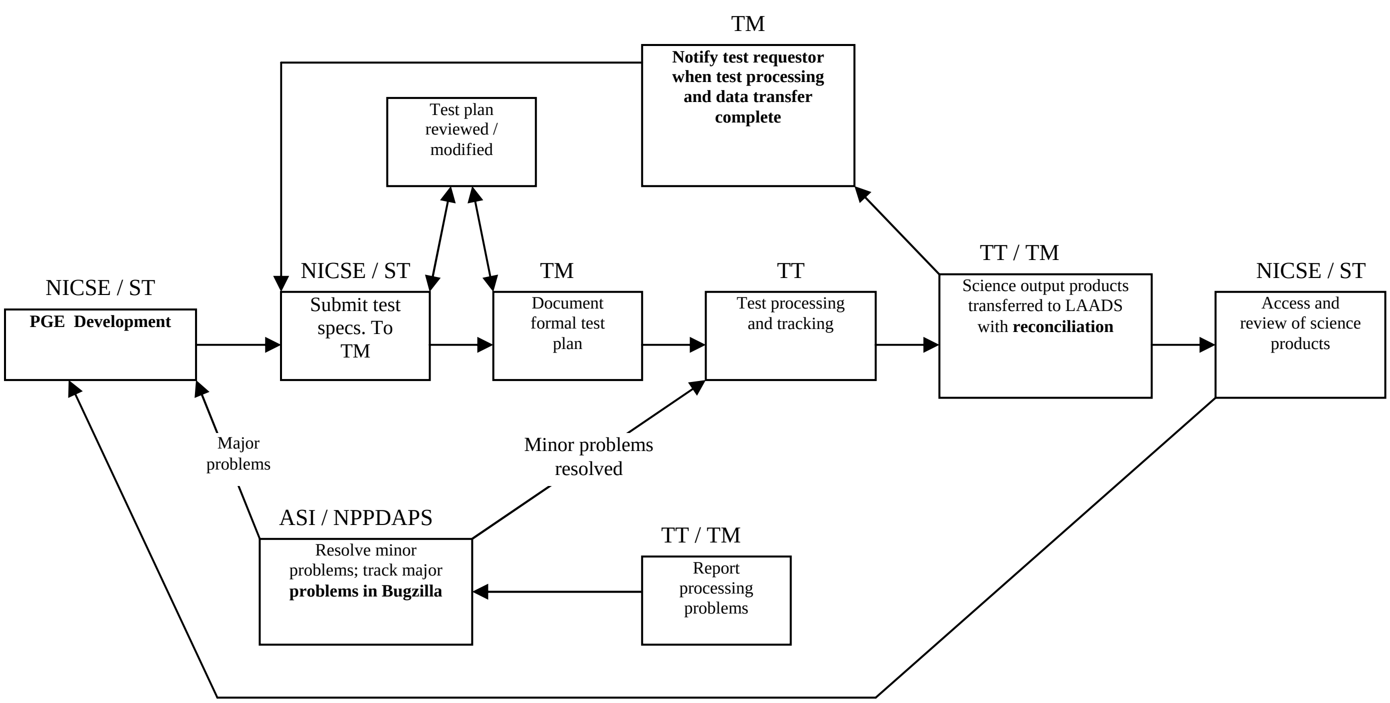

Figure 2.2.8 Science Test Process Flow

STEP 1. The NICSE/ST staff will submit their test requirements to the TM by e-mail. The TM will generate a Test Plan (TP) to include the following: test number (Section 2.2.4.3.3.1), test objective, archive set, test schedule, PGE versions to be executed, estimated data volume, xDR data sets to be inter-compared with the test results, test approach, and special instructions. The TP will be reviewed and approved by the requester prior to starting the test. A sample TP is shown in Figure 2.2.9. The TP will be included in the Land PEATE Web Site (Section 2.2.4.5) and will be archived in SVN (Section 2.2.4.1).

<u>TEST NUMBER: 4.1.3.</u>

<u>PLAN DATE: October 1, 2005</u>

<u>TEST OBJECTIVE</u>: To test updates to the Land Surface Reflectance PGE and the resulting downstream effects.

<u>PLANNED TEST DATES</u>: October 15-27, 2005

<u>MACHINE/ARCHIVE SET</u>: npp3/AS12

<u>TIME INTERVAL TO BE PROCESSED</u>: Datadays 025 through 032, 2006

<u>PGE VERSIONS TO BE EXECUTED</u>:

PGE303 v2.1.3
PGE311 v2.3.6
PGE307 v2.1.3
PGE 349 v2.1.5
PGE 356 v2.1.6
PGE 355 v2.1.6
PGE 316 v2.1.7

<u>TEST APPROACH</u>: This test will not run on an unattended base because of the new PGE311 production rules

<u>SPECIAL INSTRUCTIONS</u>:

1. The data products will need to be password protected (see 8/19 e-mail from Eric Vermote)
2. The algorithm developers require that the test products will be password protected. The necessary account name and password should be established and made know to Eric Vermote for forwarding to other individuals involved in assessment of the test results.
3. This test is considered to be very high priority and should take precedence over any other tests being performed. (See ST e-mail to Mike Teague dated September 15, 2005)
4. The proxy generator will be required to obtain the necessary inputs for the PGE.
5. A baseline will be required using the current IDPS-baselined PGE set. This will be placed into AS13.

Figure 2.2.9 Sample Science Test Plan

STEP 2. The TT will execute the TP including running the Proxy Generator, if necessary, and executing the PGE codes to generate the required test products including the generation of a baseline data set if required. All science tests will be performed in instance of MODAPS. In most instances the test will proceed on an "unattended" basis i.e. the production rules for each PGE will include the upstream dependencies and successive PGEs in a chain will execute automatically with manual intervention. MODIS currently uses an "x-chart" tool to track the test data production on a daily basis; the TT will use this tool to track production for the Land VIIRS tests. The TT will also track the transfer of data products from production disk into the LAADS archive disk and will perform reconciliation between these two using the Product Summary Reports currently used on the MODIS project to support a variety of functions including reconciliation. Once data reconciliation has been confirmed by the TM, the Product Reconciliation Reports will be entered into SVN and data products will be deleted from production disk. All data products will be maintained in LAADS until released by the requester(s). The TT will report all problems encountered during the execution of the test and will work with the Algorithm Software Integrator and the MODAPS staff to correct minor problems during the test run. More significant problems will be entered into the Bugzilla (Section 2.2.4.2.6) system for formal tracking and subsequent correction.

STEP 3. When the test has been completed, the TM will e-mail the test requester(s) and will provide data access information. This information will also be included on the Land PEATE Web Site. LAADS will provide the principal requester access mechanism to science test data products. However, for small tests involving, perhaps, a small number of PGEs and short time intervals it will be more efficient for the requester(s) to obtain data directly from production disk. The TM will identify this requirement in the TP and will update the TP to report actual test results to include: actual schedule, problems encountered, and test results. This "Actual" report will be archived in SVN.

The TM/TT will perform a number of support functions for science testing including:

- Maintenance of the xDR database. Figure 2.1.6 illustrates the flow of xDRs and IPs into the Land PEATE from the SD3E and CLASS. These data will be maintained in a standalone disk farm as shown in Figure 2.2.4. The TM/TT will ensure that orderly flow of data into the disk farm. The data will be stored in units of integer days on the individual file systems within the farm. This practice follows the successful procedure adopted for the MODIS L0 archive and minimizes problems associated with data replacement in the event of file system failure. The TT will assign days to the file systems in a round robin fashion an will use an existing MODIS Disk Utilization report to identify the volume utilization per file system and the location of each dataday within the farm. The TT will also re-acquire any lost data from the CLASS.
- Data product export to the I&TSE. As shown in Figure 2.1.6 the Land PEATE will periodically export data products to the mini-IDPS for operational testing. At the direction of the TM, the TT will export such products. This will normally be performed from the LAADS.
- Acquire ancillary data. The TT will acquire all required ancillary data sets from NCEP and the USGS. These data sets will be maintained on production disk.
- Perform disk maintenance. It is expected that many of the Land VIIRS science tests will generate substantial data volumes (possibly as high as 10TB). The TM/TT will be responsible for ensuring that sufficient production disk and LAADS archive disk space is available to execute planned science tests. If necessary the TM will negotiate with the NICSE/ST staff to ensure that this situation prevails and that pre-existing data products will be released. The TT will use existing MODIS Disk Management tools to monitor the archive set data volumes on the production and archive disks.

- Correct for data loss. Although a rare occurrence, it is expected that hardware failures will result in the loss of one or more file systems in production or LAADS archive disks. Identification of such a problem is the responsibility of the Systems Administration staff. The TT will regenerate any missing data as quickly as possible. In most instances the input xDR data for the test will be available on both disks and therefore one copy will remain on npp3/LAADS. In the event this is not the case the TT will re-acquire the input products from the xDR archive.

2.2.4.3.3.1 Versioning Science Tests

The TM will utilize a four digit versioning approach for the science test numbers. These digits will be assigned as follows:

- First digit. Science tests will be performed in order to evaluate xDRs and to improve science algorithms. The first digit will be set to 1, 2, or 3 if the principal purpose of the test is to evaluate RDRs, SDRs, or EDRs obtained from SD3E/CLASS. The first digit will be set to 4 if the principal test objective is to improve a science algorithm.
- Second digit. The second digit will indicate the IDPS drop number. For example, 1 will be used to indicate drop 1.4 in June 2006 and 2 will indicate drop 1.4m in June 2007.
- Third digit. An example PGE chain is shown in Figure 2.1.7. The third digit will be used to indicate the chain utilized in the test e.g. a third digit of 3 would indicate the L2 Land chain.
- Fourth digit. This digit will indicate the test series number assigned by the TM. For example, test 3.2.4.6 would indicate the sixth in a series of tests to evaluate the EDRs corresponding to the IDPS drop 1.4m EDRs using the L2 Ice chain and 4.1.3.2 would indicate the second in a series of tests to improve the science algorithms in the L2 Land chain in comparison to the drop 1.4 IDPS algorithms.

As noted the test version numbers will be archived in SVN. Periodically, the TT will use SVN to generate test metrics.

2.2.4.4 Document Library

The Document Library will be implemented as an organized repository of all electronic documents for the Land PEATE under the SVN system. The SVN Repository will contain several high-level directories for grouping and storing the various types of documents of interest to the Land PEATE and the ST. Each primary directory will correspond to the origin of its contents and will have paths to relevant source code and documents.

These high level directories are the following:

- CasaNOSA
- Science Team
- NICSE
- Land PEATE

Under each of these directories will be a "/DOC" for the documents. See Section 2.2.4.1 for a detailed description of the directory structure. Documents for the library will be written in Microsoft Word, PDF, and text format. The corresponding file extensions will be ".doc", ".pdf", and ".txt". Corresponding documents in PDF will also be generated and stored for all Microsoft Word documents.

The interface to the repository will be the Command Line. Any user with access to the SVN Repository will be able to view and copy or checkout any version of the documents. SVN will track and store subsequent versions of any of the documents using the Land PEATE CM procedures. An assumption is that only the documents under the Land PEATE directory will be checked out for editing updated versions and then checked in under another version. However, SVN will allow updates in other directories and Land PEATE's CM may easily expand its system to accommodate other updates.

CM has developed the SVN procedures described in Section 2.2.4.1.2 for accessing the documents. Details concerning the commands available for the Document Library may be obtained from the SVN website at http://svnbook.red-bean.com SVN also provides the capability for attaching a user-selected version label that consists of a tag on the file. This tag is added when a document is ready to be baselined. CM has developed a procedure for attaching a tag indicating a user-named version for a document to be baselined. CM will run this procedure for all baselining of documents.

2.2.4.5 Web Site

2.2.5 Evaluation Processing System

NPPDAPS system developers will be responsible for all NPPDAPS and LAADS system development, update, maintenance and support.

2.2.5.1 NPPDAPS

The NPPDAPS, modified and enhanced from MODAPS system, will be used by Land PEATE to perform VIIRS Land algorithm enhancement and xDRs data quality evaluation. In general, the NPPDAPS will be a flexible, highly automated, distributed, database-controlled system based on processing, archive, storage, database and web servers linked by high speed network connections, which will provide data collection, processing, and distribution functions. The Relational Database Management System will be the primary component of the NPPDAPS that provides system configuration, decision-support, data cataloging, and transaction processing function within the NPPDAPS. The NPPDAPS will have one operational database and will be comprised of a number of subsystems that perform specific functions, as well as graphical user interfaces (GUIs) that provide user-friendly mechanisms for controlling, monitoring, and configuring the NPPDAPS system. The major NPPDAPS subsystems, as shown in Fig 2.2.10, are described in this section.

The Scheduler subsystem controls the scheduling and running of tasks in the NPPDAPS system, and it consists of two parts: one Scheduler, and a Controller for each host on the system. The Scheduler considers all requested and time scheduled tasks, their priorities, requested vs. available resources, ages, etc., and decides which tasks should be run on which hosts and assigns the appropriate resources. Each Controller will run and track the tasks assigned to its host.

The Loader subsystem of NPPDAPS will be responsible for planning and scheduling Recipes (groups of PGEs) based upon the recipe names and ranges which will be processed. The Loader creates RecipeInstances that uniquely identified by Recipe Name, version, profile, PGE_StartTime, etc. The Loader, together with PGE Loader modules that implement PGEs Production rules, will provide lists of input files and dynamic runtime parameters to PGEs, and stage (and decompress if necessary) the input files for PGEs to run.

The PGE (processing) component of NPPDAPS is responsible for running scheduled Recipes and thus creating NPP data products, such as DDRs. Each PGE is run by a PGE Perl script, which creates a PCF file that contains all input files names and runtime parameters, runs the executables in the PGE, and archives the output products and the PGE run statistics.

The Import subsystem of NPPDAPS will be responsible for importing xDRs, IPs, ancillary data, LUTs and other VIIRS data from external data providers, like SD3E, CLASS and IDPS, as well as Land ST, and ingesting the data into NPPDAPS. Since SD3E will be a primary data provider, an Import daemon job will constantly search and ftp-pull the data from SD3E ftp server. Cksum will be used for verify the data integrity when the data will be transferred to and ingested into NPPDAPS.

The Archiver component of NPPDAPS will be responsible for storing and retrieving files for use of other NPPDAPS components. This includes moving files between archive disks, archive files to archive, Data Pool, and storage disks. NPPDAPS will use distributed archive hosts and disks, and can be configured for permanent archive and rolling archive.

The Metadata subsystem will be used to store parameters about data products in the NPPDAPS, such as geolocation information (Gring and BoundingCoordinates), Data Time Range, satellite/instrument, Orbit information, data ingest time, ESDT, Filename, Day/Night flag, Tile/Granule mapping, PGE version, product QA information , etc. All the metadata will be used to select correct inputs for generating DDRs, and used for data searches and orders.

The main purpose of the Export subsystem will be to deliver xDRs, IPs, ancillary data, DDRs, and QA data to specific destinations based on such requests. The Export uses two different ways to receive and configure orders from users: Standing Orders and WWW orders. Normally the Standing Orders will be limited to ST members only. Data can be delivered through ftp-pull, ftp-push, or http download as users prefer. Users can not only order data in original format, but also order post-processed data, such as subsets, data on different projection types, mosaiced data, etc.

The WWW subsystem provides a web interface to the NPPDAPS system. In addition to allowing users to browse and order data from the archive, the WWW subsystem also provide status reports and metrics on NPPDAPS processing and information about the NPPDAPS.

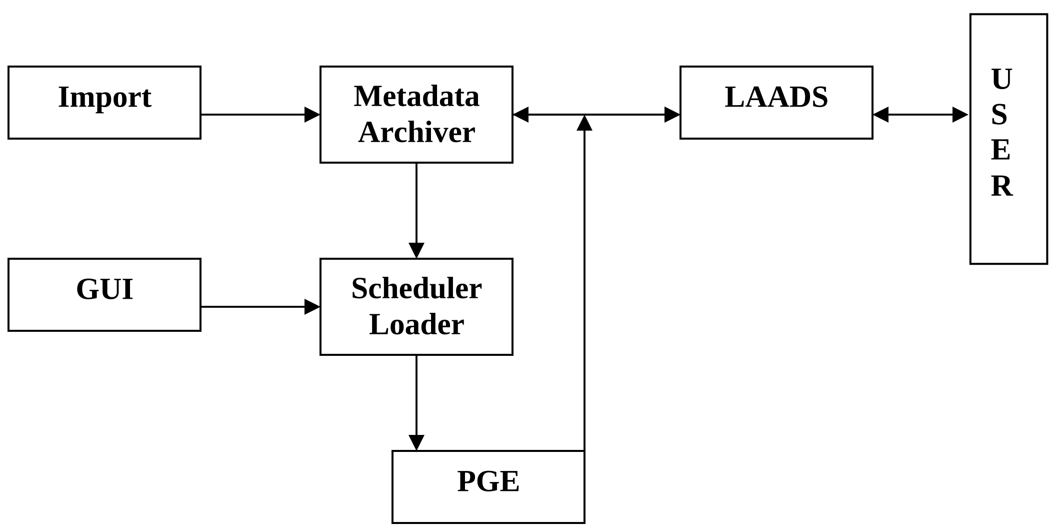

Figure 2.2.10 Major NPPDAPS Subsystems

2.2.5.2 LAADS

LAADS will be an archive and distribution version of NPPDAPS. With most major subsystems of NPPDAPS, LAADS will have three additional components: Processing-On-Demand (POD), DBsync, and Post-process, as shown in Figure 2.2.11. The same subsystems in NPPDAPS and LAADS have been described in 2.2.2.7.1, and the subsystems only in LAADS will be discussed here.

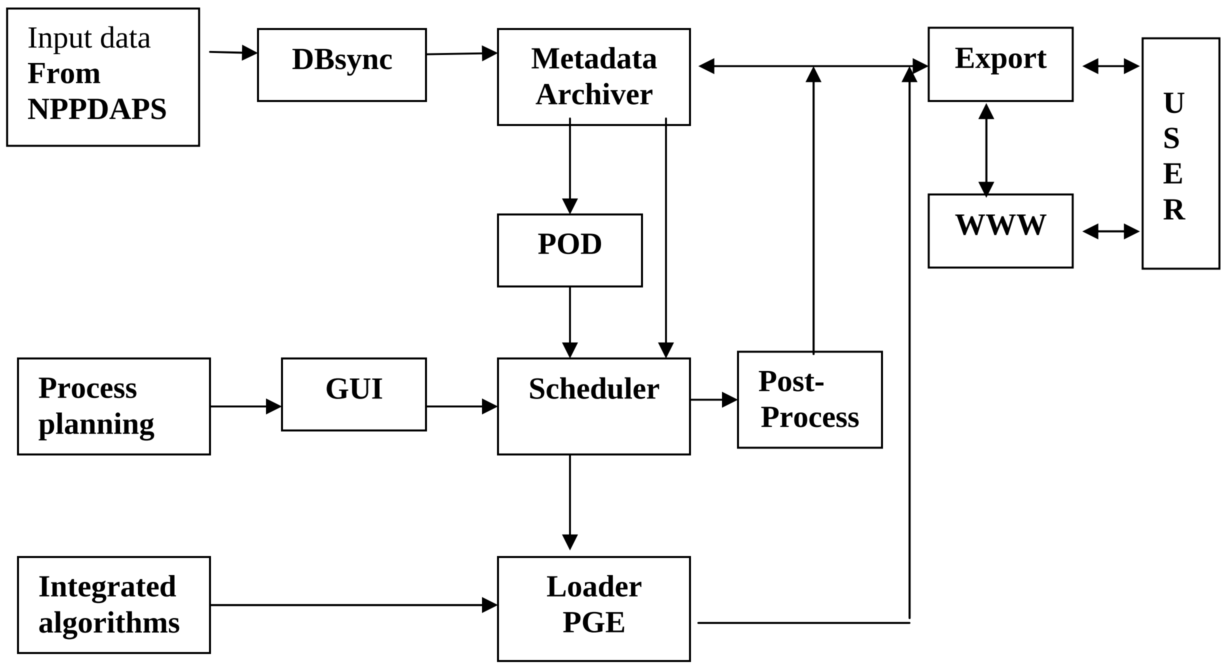

Figure 2.2.11 Major LAADS subsystems

Certain xDRs/DDRs will not permanently be archived in LAADS since they will require prohibitive amounts of archive disks, and some permanently archived data may get corrupted or lost. When users order some xDRs/DDRs that will be not available in LAADS archival disks, they will be flagged to indicate that the products need be generated on a POD basis. When an ordered xDR/DDR is required to generate by POD, the POD subsystem will first check and determine which PGE/Recipe will be used to generate the data, and also check if all input files of PGE/Recipe exist in LAADS. The same step will be repeated until all required input files exist on disks. Then POD system will then automatically insert a series of PGEs/Recipes into LAADS system, which will be manually performed by operators in NPPDAPS GUI subsystem. Thereafter the LAADS will work the same way as those in NPPDAPS to run the PGEs/Recipes to generate the ordered data. Normally, the data generated by POD will be archived in LAADS for certain days only in order to being downloaded by users.

When xDRs/DDRs will be ingested in NPPDAPS, they will be transferred to LAADS archive disks automatically. DBsync in LAADS system, similar to Import in NPPDAPS system, will then syncs the xDRs/DDRs metadata, including the associated PGE metadata, from NPPDAPS database to LAADS database, and put the physical data files in LAADS archive directory structures. The PGE metadata will be needed in LAADS specifically for POD.

From LAADS, users can order not only archived xDRs/DDRs themselves, but also post process data of them, like subsets, mosaics, re-projection and reformat data. Post-Process subsystem is developed specifically for the post-process orders. Once post-process orders will be inserted into LAADS, they will go through the following stages: Scheduler schedules Post-Process Tasks to process the files in the order; POD minions pick up the Post-Process Tasks to generate the files; Export stages output files to a directory on the FTP site so the user can download the files, or, if requested, the Export can FTP push them to a user's site; export also will remove staged files from the FTP site after a predefined number of days so that resources can be reclaimed. E-mail will be used to inform the user concerning order information.

LAADS Post-Process will assign an appropriate set of engines to accomplish the post-processing operations specified by the user. Currently, all combinations of the following operations will be provided: subset by SDS; subset by geographic area of interest; aggregate a set of files into one file (mosaic); re-project data to different map projections; and create .tif formatted files.

Besides the three additional subsystems, LAADS has an enhanced WWW subsystem that has many more advanced features for users to search and order data (Section 2.1.5.2).

LAADS web search page will allow users to search for xDRs/DDRs by specifying the following, but not limited, criteria: ESDT name, file name, temporal and spatial ranges, ArchiveSet, Day/Night flags, orbital numbers, TileId, and some QA metadata. Users can also search data by browsing data images, including global, granule and tile images. Various data download methods will be provided in LAADS: wget, http, ftp-pull, and ftp-push. Once the archived xDRs/DDRs will be ordered, the data order confirmation and data download instruction will be immediately given on LAADS web page, and by email if user's email address is given.

The LAADS WWW subsystem also provides user the data availability information for all data archived in LAADS, the Order Track page to track user's previous orders, and the Tools page that lists many useful tools and download sites.

2.2.6 Infrastructure

The Land PEATE infrastructure includes the following items:

- Building Space and Networks
- System Administration and Facilities Management

2.2.6.1 Building Space and Networks

Computing systems and personnel supporting the Land PEATE will be located in Building 32 at the GSFC and at the SSAI facility at 7501 Forbes Boulevard.

The product generation, data archive, data distribution and quality assessment systems of the Land PEATE will be located on the ground floor of GSFC Building 32. Physical access to these systems, which will be attached to the NASCOM mission network, is controlled through electronic cardkey readers. The compute servers, database servers and RAID storage arrays will be located on raised floor in the S-009 computer room. The 14 racks, which hold the Land PEATE servers and disk storage, will be arranged in two parallel rows occupying 144 square feet on the computer room floor. Power for the Land PEATE systems in this area will be supplied through a 75 KVA Power Distribution Unit connected to Building UPS #5. Heat loads from the Land and Ozone PEATE and other computer systems planned for installation in S-009 over the same period have been discussed with the building engineering team which has determined that the planned equipment will require an additional 36 tons of cooling that can be provided by the current air handlers in S-009.

Building 32 will also houses members of the NPP ST, system administrators, facility management personnel and the LDOPE team which assists the ST in assessing the quality of VIIRS Land EDRs. The LDOPE team workstations in S-031 and system administrator workstations in S-033 will be directly attached to the NASCOM mission network via 100Mbps connections to facilitate access to Land PEATE systems and data products. Access to both rooms will be restricted by electronic cardkey readers. ST members and facility management personnel will be located in standard office space and their access to the Land PEATE is through the GSFC campus network at rates of 10Mbps for facility management personnel and 100Mbps for ST Members.

The software development, software integration and operations teams supporting the Land PEATE will be housed in the SSAI offices at Forbes Boulevard approximately 2 miles from GSFC. Workstations used by these teams will be connected to a local area network at 100Mbps. Firewalls running on Linux servers restrict traffic to and from the Internet on a leased T1 line and to and from GSFC on a fractional T3 connection.

2.2.6.2 System Administration and Facilities Management

The Land PEATE will be co-located with other operational processing systems (MODAPS and OMIDAPS) and PEATES (OMPS PEATE) and its system administration support will be provided by 3 system administrators, who support these projects. Basic system administration services will include hardware installation and maintenance, installation and maintenance of the operating systems and open source software, system backups, IT security activities and system-wide utilities and tools that will make for a general purpose computing facility. The Land PEATE will also share facility management services with the other projects including planning for infrastructure upgrades such as power and cooling and network connectivity, property management and ordering computer equipment, software and supplies.

2.3 Operational Examples

The Land PEATE functions were introduced in Section 2.1 (Logical Design). Implementation of the functions is covered in Section 2.2 (Implementation). This Section 2.3 integrates the general information given in these sections into specific examples. First is an example of the current operations showing how existing Science versions of the Algorithms were integrated into the Land PEATE (Section 2.3.1, Current Operational Example). Then an operational example is given for the Land PEATE after the launch of VIIRS on NPP (Section 2.3.2, Post-launch Operational Example).

2.3.1 Current Operational Example

VIIRS science code and associated test data were obtained CasaNOSA (“Home” of NOAA Observing System Architecture). For these algorithms we applied the MODIS Science Data Support Team paradigm for code integrating and unit testing outlined earlier in Section 2.1.4.1. The MODIS PGE numbering scheme was adapted for NPP with a 300 series of numbers. In other words, MODIS geolocation is designated as PGE01 and the corresponding VIIRS geolocation is designated as PGE301.

For the initial integration, we concentrated on a core group of VIIRS PGEs to integrate into a processing chain. The chain includes the science PGEs 303, 304, 311, and 327; the granulation PGEs 353 and 354; (see Table 2.3.1). These PGEs and the NPPDAPS processing system were the basis for Build 1 of the Land PEATE delivered in March 2006.

Table 2.3.1 NPP/VIIRS PGE Algorithms in Build 1

PGE Name	PGE Description	Type of Output Product
PGE303	Cloud Mask	IP
PGE304	Aerosol Optical Thickness	EDR & IP
PGE311	Land Surface Reflectance	IP
PGE350	VIIRS National Centers for Environmental Prediction (NCEP) Global Forecast System (GFS) 750m Granulation	IP
PGE352	VIIRS Global Land Cover 750m Granulation	IP
PGE353	VIIRS Gridded IP 750m Granulation	IP
PGE356	Normalized Difference Vegetation Index (NDVI)	EDR

Figure 2.3.1 shows a schematic data flow diagram for this chain. The chain starts with VIIRS proxy Science Data Record (SDR) data that is obtained from NGST. The first processing step of the chain involves running the granulation PGEs 350 and 353 that respectively convert gridded NCEP data and gridded VIIRS data to swath coordinates that will then be read by the PGEs. In the Build 1 timeframe only 1.2 orbits of SDR data were available for testing PGE integration so PGE 318 that required multi-day input was not included in the processing chain.

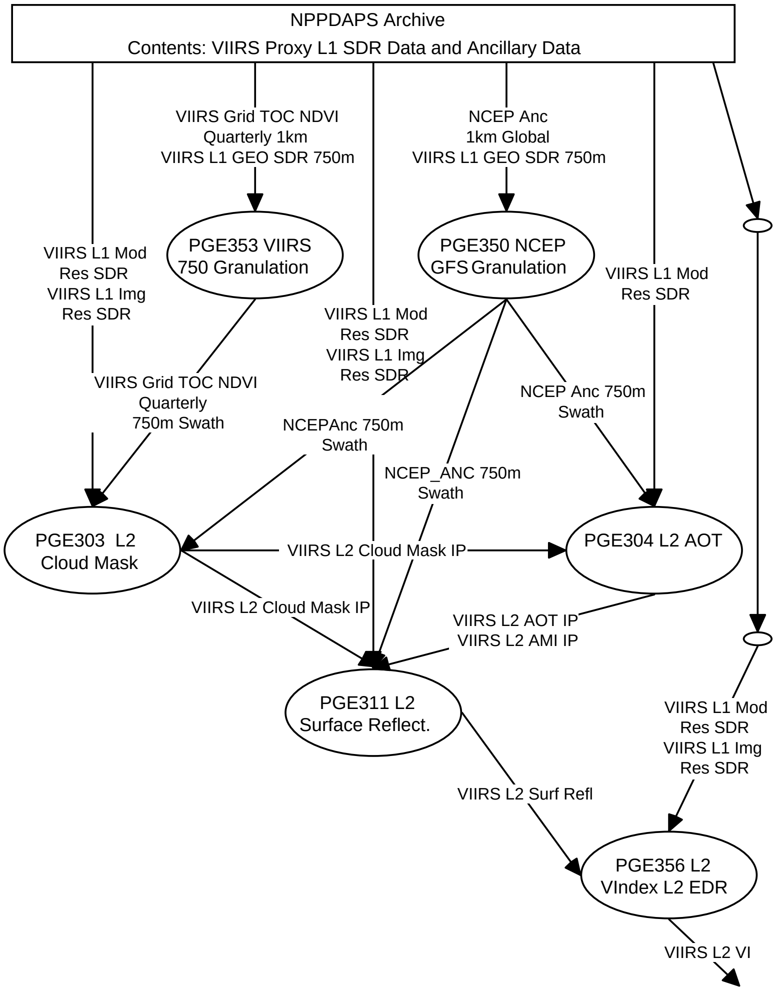

Figure 2.3.1 Prototype Land PEATE Science Code PGE Chain

During the integration process science software was tested in several systems. In the Engineering Test System, command line tests were first performed on nppdev to validate the science code by comparing the outputs with test outputs provided by the developers. Next the science code was integrated with Perl scripts that implemented the production rules (what inputs to stage for processing). These integrated units, the PGEs, were then tested on a MODAPS production system, mtvs3, as at the time of Build 1 there were no NPPDAPS processing strings.

A synopsis of the production rule for science PGE 303 is shown in Figure 2.3.2. This synopsis was developed from production rule documentation that is kept online under configuration management. The term ESDT in the following documentation refers to the ECS defined Earth Science Data Type which is used to store and track output products in the EOSDIS. The formal production rule documents contain additional information such as the SDR bands used by the science algorithms.

Synopsis of NPP/VIIRS PGE303 (Cloud Mask) Production Rules

Program: NPP_PRCldMsk

Inputs (All inputs use satellite swath coordinates):

ESDT	Origin	Description
NPP_VIAE_L1	VIIRS	Imagery Resolution SDR (swath)
NPP_VMAE_L1	VIIRS	Moderate Resolution SDR (swath)
NPP_VSNICIP_L2	VIIRS	Snow/Ice Cover (swath from grid)
NPP_VNDVIIP_L2	VIIRS	Normalized Difference Vegetation Index (swath from grid)
NCEP_WSPDIP_ANC	NCEP	Wind Speed (swath from grid)
NCEP_PRWIP_ANC	NCEP	Precipitable Water (swath from grid)

Outputs:

ESDT	Description
NPP_CMIP_L2	Cloud Mask (swath)

The following LUT is used: vcm.cfg – Cloud Mask Configuration File

NPPDAPS Production

PGE303 tentatively runs first in the MODAPS V2 Recipe N1, which is executed daily upon the availability of VIIRS Moderate and Imagery resolution inputs. PGE303 requires the following ancillary or Level-2 inputs : NCEP Sea Surface Winds EDR, USGS Ecosystem EDR, VIIRS Snow and Ice EDR, Precipitable Water EDR, and VIIRS Normalized Difference Vegetation Index (NDVI) EDR. All of the inputs use satellite swath coordinates. PGE303 produces a maximum of one granule of NPP/VIIRS Cloud Mask for each run. Output ESDTs will be tentatively set to NPP_CMIP_L2.

Dynamic Runtime Parameters for Operations

SatelliteInstrument <Spacecraft platform for VIIRS Instrument supplied by NPPDAPS. Value = {NPP, NPOESS}
ProcessingEnvironment <Example: "LINUX64 modular 6.5 011 01245 IP27">
PGEVersion <Version of PGE303 that appears in the ciList delivered with the code>

Figure 2.3.2 Synopsis of NPP/VIIRS PGE303

2.3.2 Post-launch Operational Examples

This section discusses operational examples in the Land PEATE following launch. The sections explain how the functions will be used together (Section 2.3.2.1, Work Flow) and how the functions will stimulate the physical parts of the processing system (Section 2.3.2.2, Hardware Interaction).

2.3.2.1 Work Flow

In the post-launch period, data products produced by the IDPS and the MODIS processing system, ancillary data files, xDR generation software from IDPS and software improvements from science team will be received by the Land PEATE for the purpose of analysis, integration into the production system or as an input for processing.

Figure 2.3.3 illustrates the work flow in the Land PEATE associated with changes in product generation software in the post-launch period.

When new software is received in the Land PEATE system it is placed under configuration management along with its test files and documentation awaiting an integration step that will convert the software from its native environment to a PGE that can run in the MODAPS processing framework. As illustrated in Figure 2.3.3, there are three sources of software updates: operational code from the IDPS, improved algorithms developed by the ST and software developed by the Land PEATE team to produce DDRs, global browse or other QA related products such as subsets over LTER (Long-Term Ecological Research) sites.

After the software is placed under configuration management, it proceeds through integration and test steps described earlier in Sections 2.2.4.2 and 2.2.4.3 wherein the software is transformed from its native form into a PGE that will run under the NPPDAPS framework and is verified through a series of tests to be ready for use in large scale science tests. The purpose of these science tests is to generate SDRs and EDRs with improved software that the science team and LDOPE can compare with SDRs and EDRs generated by IDPS operational software in order to assess the improvement in the SDRs and EDRs resulting from the ST and NICSE's improvements to the IDPS operational software. When the ST and NICSE are satisfied that their improved software produces substantial improvements in the quality of VIIRS SDRs or EDRs, the improved software and analysis of SDR and EDR quality will be sent to the PSOE.

Not shown in Figure 2.3.3 is detail concerning the flow of improvements from the Land PEATE to the PSOE. Software improvements may be sent either in a form native to Linux, or as deltas to IDPS software. To generate IDPS software deltas, candidate improvements will be first sent to the "mini IDPS" located within the SDS I&TSE. The improvements will be tested and possibly modified until the "mini IDPS" produces the same results as NPPDAPS. As tests succeed, modified IDPS software, or deltas to IDPS software, will be sent to the PSOE.

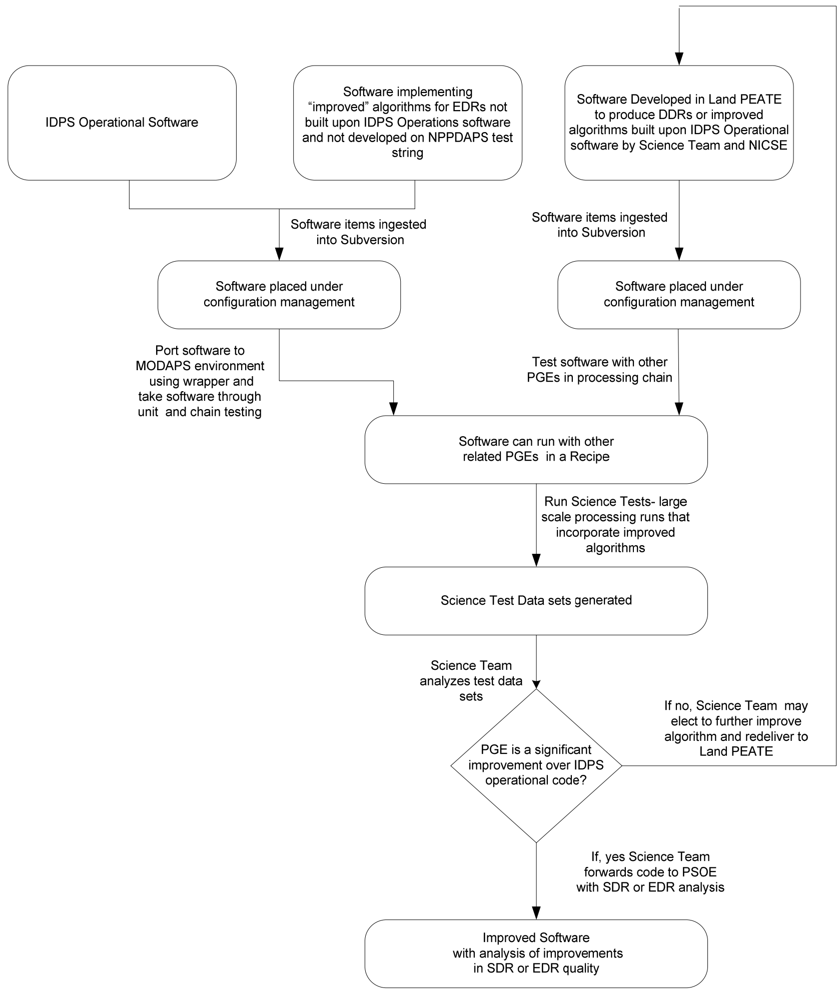

Figure 2.3.3 Work Flow in the Land PEATE for Changes to PGE Software

Workflows associated with product generation and product evaluation in the Land PEATE are shown in Figure 2.3.4. Overall there are three major activities involved in producing and acquiring products used in subsequent analyses of product quality by LDOPE, NICSE and the ST. These are daily production of DDRs from SDRs and EDRs generated by IDPS operational software, science testing and production of DDRs from SDRs and EDRs produced in the science tests and quality assessment of SDRs and EDRs by LDOPE, NICSE and the ST.

The first workflows in the PEATE are the generation of DDRs, global gridded products (comparable to MODIS Level 3 Land science products) and browse products that are used by LDOPE. DDRs are produced for xDRs received from the IDPS and ingested into NPPDAPS from SD3E or CLASS [flows (1)-(3) in the figure below]. These DDRs are produced on a daily basis keeping pace with IDPS production to allow the LDOPE and Science Team to trend the SDRs and Land EDRs and identifier outliers that require further investigation.

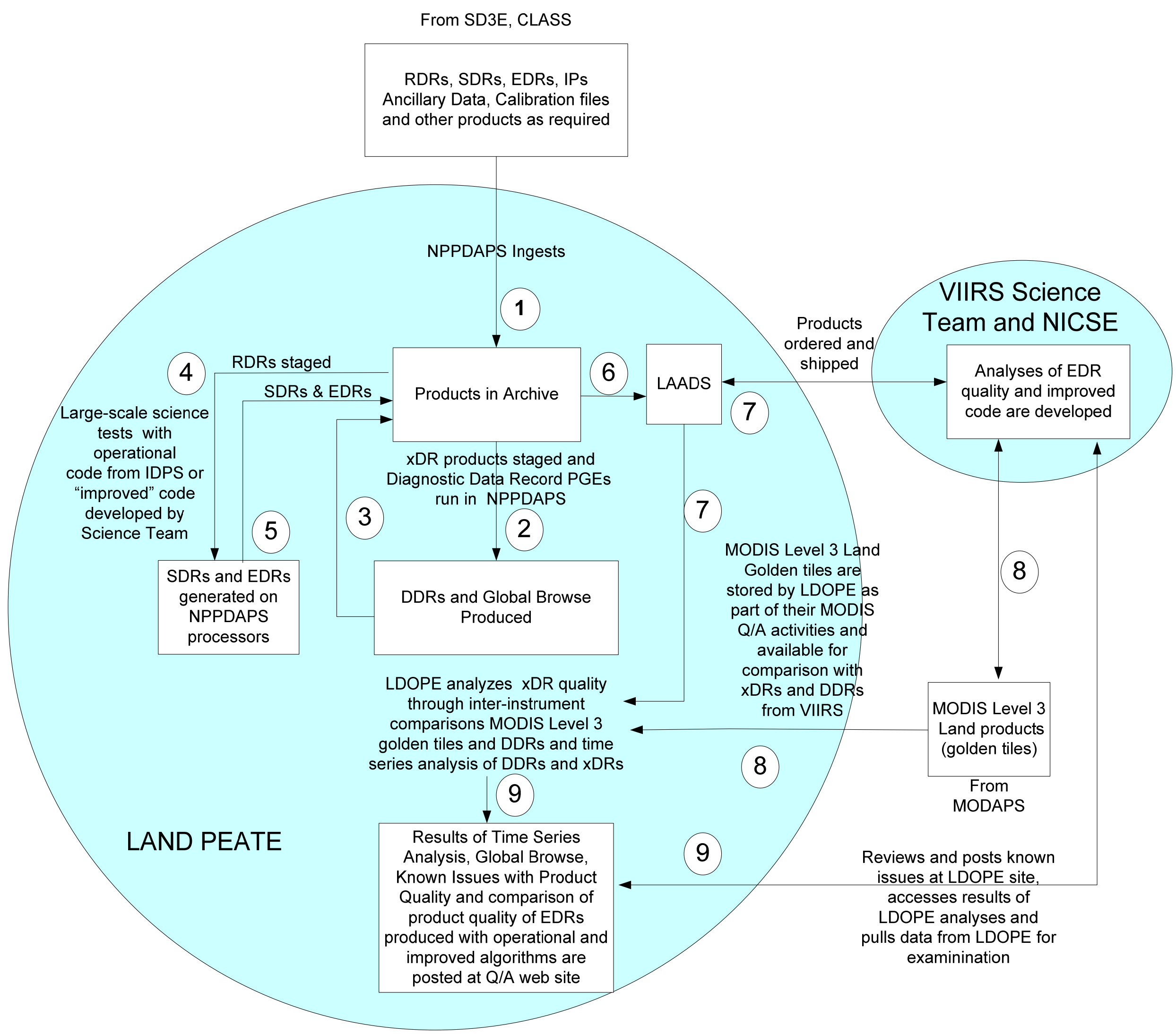

Figure 2.3.4 Work flow in the Land PEATE for Evaluating SDR and EDR Product Quality

In the second workflow, science tests produce two streams of products, one set made with using current IDPS operational software and the other using “improved” science algorithms developed by the Science Team. The science tests produce many days of products over a limited spatial area, such as the golden tiles, or global coverage for a limited time period such as a month. The science tests are scheduled at the request of the ST and differ from the routine generation of DDRs in that many data-days must be produced each day to enable the ST to assess the results of the tests and further improve, if necessary, the product generation software. As illustrated in flow (4) input products needed to run the science tests (RDRs and ancillary data) are staged from the archive, produced in NPPDAPS and SDRs and EDRs are sent to the online archive (flow 5). These SDRs and EDRs are also used to generate DDRs (flows 2 and 3) which form the basis for subsequent analyses by LDOPE, NICSE and the Science Team.

In the third workflow, quality assessment of products produced by the NPPDAPS production system the Science Team, NICSE and LDOPE order products from the online disk archive and receive delivery of products via the LAADS system [flows (6) and (7)]. All three groups analyzing VIIRS product quality, LDOPE, NICSE and the ST, also order MODIS products via a separate instance of LAADS on the MODAPS system [flow (8)] for comparison with similarly gridded DDRs produced from VIIRS SDRs and EDRs. Results of their analyses are posted at the VIIRS Land QA web site [flow (9)] where know issues related to product quality are described. Details on the LDOPE QA processes were provided in Section 2.2.2.2 and post-launch QA workflows are described in Section 2.3.2.3.

Based on our experience with the MODIS instruments on EOS Terra and EOS Aqua, we believe that most of the effort in the first 6-9 months after launch will be spent on improving the quality of the VIIRS SDR. Once the SDRs reach an acceptable level of quality, the assessment of EDRs and efforts to improve them can begin in earnest. That is not to say that the software and processes required to assess EDRs won’t exist in the early post-launch period, they will and assessments of early EDR quality will be provided. However, extensive analysis of EDR quality and improvements of EDRs will require SDRs that are close to meeting requirements for calibrated radiance and geolocation accuracy. In the early post-launch period, problems stemming from the SDRs may be more easily detected through their impact on downstream EDRs especially when the DDRs produced from these EDRs are compared with comparable MODIS Level 3 products.

2.3.2.2 Hardware Interaction

This section describes flow within the NPPDAPS. It explains what will happen when a modified algorithm is tested against large amounts of data so as to generate time series products for analysis of the software changes.

As shown in Fig 2.2.10, NPPDAPS is a data processing system that runs PGEs and imports and exports PGE inputs and outputs by Import and Export subsystems, respectively. PGEs will be integrated science/operation processes that take as input time/space delimited raw satellite instrument data, ancillary data, or data produced by other/upstream PGEs, and create output geophysical parameter files, or xDRs, and ingest/archive them into NPPDAPS by Archiver and Metadata subsystems. The system is composed of a relational database for product and PGE and system process metadata, an archive (disks) for data files, system processes that interact with the database and launch other processes (etc.), a GUI for operator control and monitoring, and web pages for monitoring and user access to data.

First of all, an improved algorithm will be unit tested and integrated into PGEs that can run in NPPDAPS environment, and all necessary input data have been ingested into NPPDAPS. To initiate processing, an operator will use the GUI interface to place into the database a production plan specifying: Recipe (list of PGEs or single PGE), start and end of time range to process, and optionally a list of profiles and/or spatial regions. The Loader subsystem schedules a Recipe instance (and corresponding PGE instances) at each applicable instance start time (and profile/spatial region) within the planned interval according to the Recipes Scheduling Rules (same for each PGE in a recipe). (For example granule-based processes will be scheduled at every five minute interval starting from midnight within the planned time interval, 288/day.)

For each scheduled Recipe instance the Loader regularly checks the Production Rules of each PGE in the instance. The production rules of a PGE (contained in a PGE's LoaderModule) determine whether the inputs needed by the PGE instance will be present in the system. If all the inputs of all the PGEs in the Recipe instance will be available, the Loader tells the Scheduler subsystem to run the instance. If the rules instead determine that the inputs will never be available, the PGE instance is marked NoRun. Otherwise the Loader continues checking the rules periodically, until operators force a decision. Production rules will be typically based on whether the inputs will be present and whether the PGE instance that would create them has run or been marked NoRun. For inputs imported into the system, a fake PGE status is entered by operators and used in production rules.

The Scheduler subsystem assigns resources to system and Recipe/PGE tasks waiting to run as the resources become available. System tasks can be scheduled to run regularly at particular times or delays after the previous invocation finishes. A Controller task on each host in the system runs and reaps the tasks assigned to that host.

The Import subsystem polls configured directories on hosts external to NPPDAPS for data files or delivery notices listing data files and imports them into NPPDAPS. In particular the NPPDAPS-SD3E interface is implemented to routinely obtain xDRs, IPs, ancillary data generated from CLASS and IDPS, and ingest them into NPPDAPS with cksum checking.

The Export subsystem monitors the database for new instances of product types configured for export or special orders create by users of the web pages. Export delivers data files to external hosts and users, or stages them for external users to obtain with ftp pull. Email or file notices with cksum information can be sent if requested.

When Loader or Export identifies product files to be used as inputs or exported, they first request the files from the Archiver subsystem. Archiver retrieves files from backup archives if necessary and returns a notice that the requested files will be available, or that some will be missing. Archiver also manages the storing of configured product types to backup.

2.3.2.3 Post Launch QA work flow at LDOPE

Figure 2.1.4 illustrates the sequence of operation within the LDOPE and its interaction with the processing system and the ST during the QA of data products. Figure 2.1.4 shows the three sets of QA DDRs that arepushed from the Land PEATE processing system to the LDOPE. These data will be input to the three cron jobs running at regular interval creating the coarse resolution global browse images from the CRBDRs, ingesting the QALDR to metadata database, and ingesting the GTSDR to the time series database. The results of these processes will be automatically posted on the web. Any error in parsing of the QALDR is reported to the ST or the production team as appropriate. Error in creation of browses and ingestion of GTSDR is investigated internally.

The QA Scientist at LDOPE will visually inspect the browses, metadata plots, or time series analysis for possible data problems. If a problem is identified then the QA Scientist will initiate a detailed investigation of the data. He will identify the sample xDRs will order the data using the LAADS. The QA Scientist will investigate the xDR for any QA related problem and will report the result of the analysis to the ST and the production or the test team.

2.3.2.3.1 QA of xDRs using Process Flow

Routine QA of even a small sample of the Land xDRs at the LDOPE is time consuming and complex because of the large number of Land products and the dependencies that exist between the products. However a Process Flow showing the hierarchy of products in the chain of production of a Land xDR can be used to rapidly identify the source of the problem and the propagation of the problem to other xDRs in the hierarchy. Figure 2.3.5 shows an example of the combined Process Flow for L2 Surface Reflectance, L2 Vegetation Index and L2 Land Albedo EDR.

2.3.2.3.1.1 Bottom-up QA Example (L2 VI -> L2 SR -> L1 SDR)

Figure 2.3.6 shows the sequence in which the products are ordered and examined if a qa related problem is first identified in a product that is at the end of the production chain such as the L2 VI EDR. The process flow is followed from the bottom to the top. Inputs used to make each of the products in the process flow will be ordered and examined to track and identify the source of the problem.

2.3.2.3.1.2 Top-down QA Example (L1 SDR -> L2 SR - > L2 Land Albedo)

If a problem is first identified in a lower order product then the process flow is followed from the top to the bottom. In the above example any QA related problem in L1 SDR may be potentially propagated to all of the downstream products in the chain of production and hence L2 Surface Reflectance, L2 VI, L2 Snow Cover and L2 Land albedo may need to be ordered and examined.

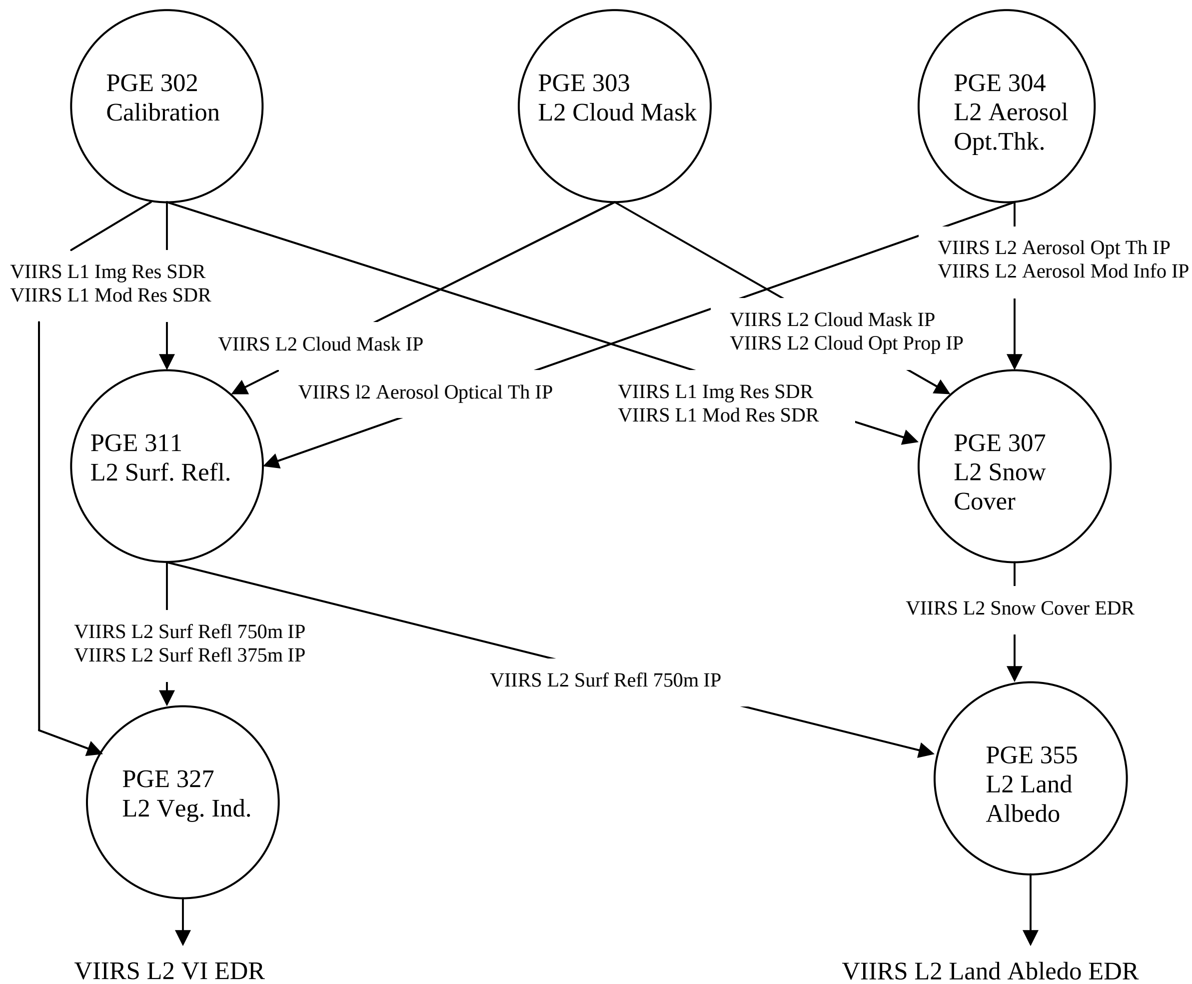

Figure 2.3.5 Process Flow L2 SR/L2 VI/L2 Land Albedo

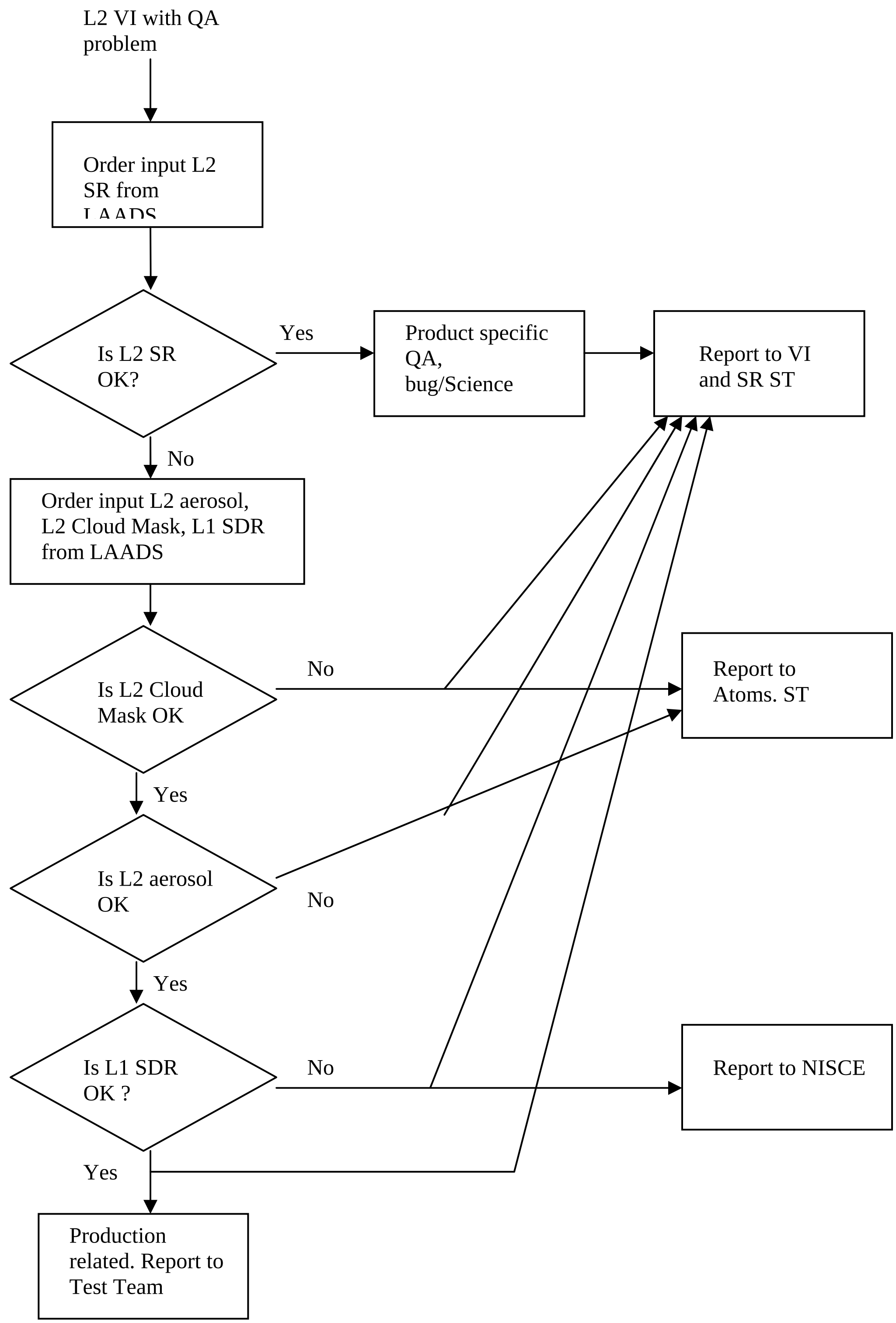

Figure 2.3.6 Bottom-up QA of VI using VI Process Flow

2.4 Gap Analysis

The Land PEATE will be hosted on an expanded MODAPS system, i.e. NPPDAPS. Modifications and enhancements to the existing MODAPS system will be needed in order to support xDR quality evaluation, subset processing, and Land algorithm enhancements. The needed modifications to the MODAPS system hardware and software are listed in the sections which follow and a deployment plan for hardware installation and software builds is provided in Section 2.5.

2.4.1. Hardware

The hardware architecture of the MODAPS system will meet the needs of the Land PEATE without modification. However, additional computers systems, storage and peripherals will be required since the current equipment is already fully used by existing projects. As shown below in Figure 2.4.1, an instance of MODAPS consists of six components: Database Nodes, Ingest and Scheduling Nodes, Processing Nodes, Archive Nodes, Web Nodes and the Network Switch, each of which are described in more detail in the subsections below.

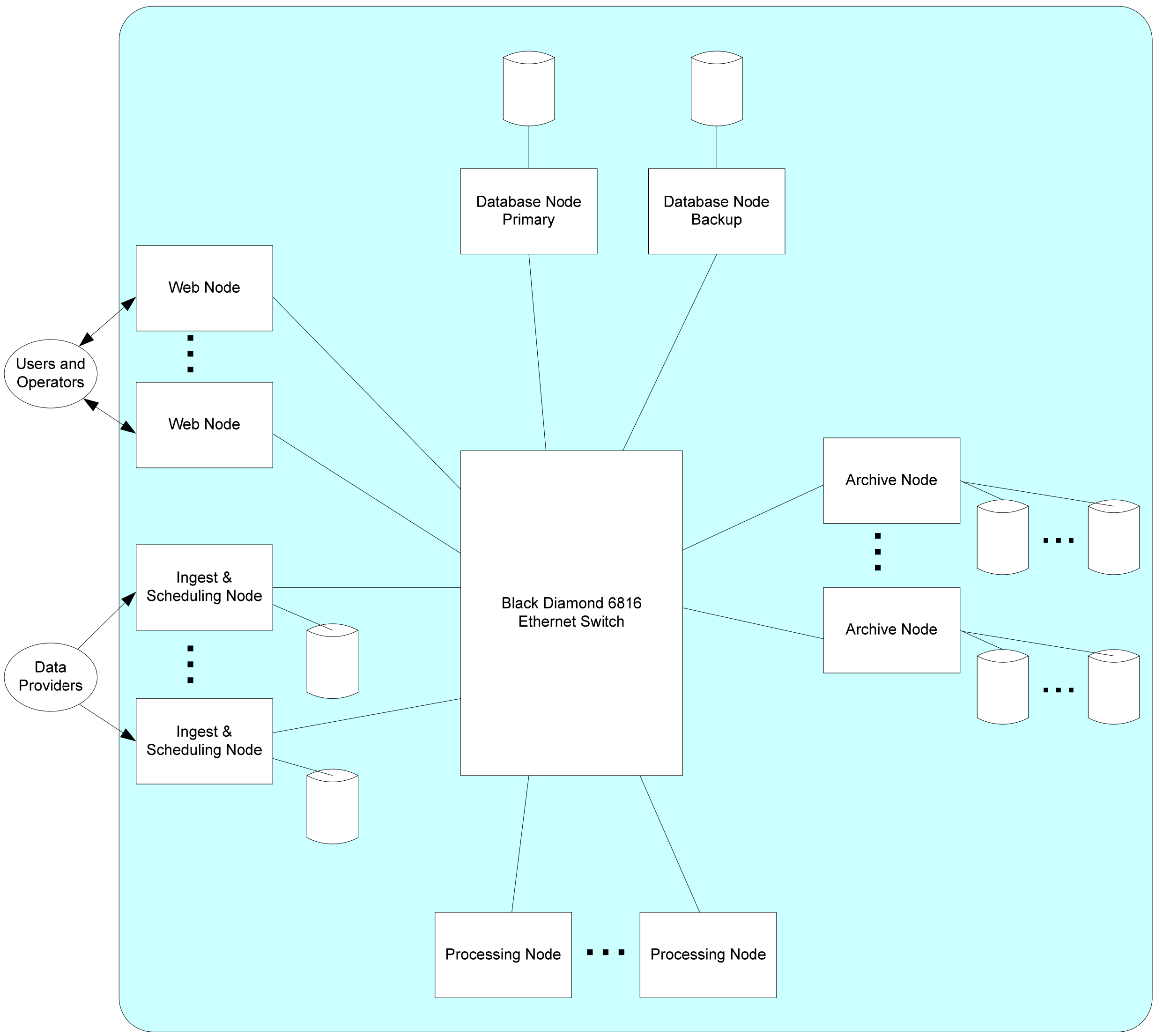

Figure 2.4.1 High-level Physical Architecture of MODAPS

While the number of processors and amount of memory, internal disk storage and SCSI interfaces may vary between the five classes of nodes within a MODAPS system, all nodes have the following features in common:

- Rack-mounted servers with Intel Xeon processors
- 76GB root disk to hold operating system and swap space
- Linux operating system (Mandrake or Centos)
- 100/1000Mbps network card
- Connection to a central network switch

2.4.1.1 Database Nodes

Database nodes as noted earlier will be Dell 2850 servers running the Sybase SQLserver relational database management system. Database nodes have large memory (8GB) and relatively large 2TB attached RAID storage. The operating system is the Centos distribution of Linux to maintain compatibility with RedHat Linux which is certified to work with Sybase. Database nodes for the production system consist of a primary database server which is used to track the status of all products on compute nodes or archive nodes and a backup database server to which database dumps will be copied and checked and from which the state of the database at the last dump can be restored should problems develop on the primary database node. Database nodes for the archive and distribution system (LAADS) will be similar except that the database is replicated between the primary and backup servers to ensure that the contents of the backup database will be always current.

2.4.1.2 Ingest and Scheduling Nodes

Ingest and Scheduling nodes will be 4 processor servers running Mandrake Linux whose purpose is to ingest files from external data providers and to schedule jobs within NPPDAPS on the Processing Nodes. Attached to each of these nodes is a 4.5TB RAID array used to hold products pulled from the SD3E, the CLASS archive and ancillary data providers. External nodes will be redundant to ensure that products will be pulled from the SD3E and other provider sites before they expire. Locally attached storage on each external node is sufficient to hold 5-days worth of files from external providers to enable the nodes to keep pulling in files even if the main system is down during a long weekend.

2.4.1.3 Processing Nodes

Processing nodes will be Dell 2850 servers running Mandrake Linux with 2GB of main memory and two 146GB drives to hold input files and products produced during processing prior to exporting these products to the Archive nodes. Production software (PGEs), coefficient files and look-up-tables will be stored on the root disk by jobs run by the configuration manager to push out the latest build of the science or operational processing software.

2.4.1.4 Archive Nodes

Archive servers will be Dell 2850 servers configured with a root drive and 2GB of memory. Six SATA-2 RAID arrays are connected to each archive server via two SCSI channels and together the disk and servers comprise an archive node. The archive servers running Mandrake Linux to facilitate rapid rebuilds of file systems in the event of file system errors.

2.4.1.5 Web Nodes

Web nodes will be Dell 2850 compute servers with 2GB of memory and a 73GB root drive. Web nodes run Mandrake Linux and have Apache and Perl installed that will be used in web pages that support: searching, ordering, production on-demand by the ST members and the Land science community and run jobs by the operations team via a web-based GUI.

2.4.1.6 Network Switch

Nodes within the Land PEATE will share the Extreme Networks Black Diamond switches with the MODAPS systems that produce the MODIS standard science products which will facilitate moving products between the two systems across the internal network comprised of the switch. The least capable of these switches has a switching capacity of 786Gbps and can route/filter/forward 192 million packets per second via 100/1000 Mbps interfaces to Land PEATE and MODIS processing nodes.

2.4.2. Software

2.4.2.1 Land PEATE External Interfaces

As noted earlier the MODAPS will be enhanced to generate NPP VIIRS data products. Much of the new work will be in developing the interfaces to external systems.

2.4.2.1.1 Land PEATE-SD3E Interface

A new interface to SD3E will be used to regularly retrieve xDRs, IPs, ancillary data, operational calibration products, and operational algorithms and source codes from SD3E, and to submit data requests to the SD3E. NPPDAPS will submit three data request orders (subscription order, ad-hoc data request, and retransmission request) to SD3E by using ftp-push to push the orders to the /NPPSD3/ftp/incoming/order directory at SD3E ftp server. NPPDAPS will run a daemon job to constantly search and ftp-pull all the new available data files in the DailyIngest directory of the SD3E ftp server:

/NPPSD3/ftp/pub/DailyIngest_EDT/YYYYMMDD/VIIRS/Land

where YYYYMMDD uses the local system Eastern Daylight Time (EDT) time.

NPPDAPS will also be able to search and ftp-pull data and algorithms from the following Searchable directories at SD3E ftp server (the YYYYMMDD here is the data date or the date the file was acquired by the instrument):

```
/NPPSD3/ftp/pub/NPP_Products
        /Ancillary
                /YYYYMMDD
                        /CollectionShortName...

        /VIIRS
                /Algorithms
                        /Version#...
                /Calibration
                        /Version#...
```

/YYYYMMDD
/RDR
/DataProductID...
/SDR
/DataProductID...
/EDR
/DataProductID...
/TDR
/DataProductID...
/IP
/DataProductID...

NPPDAPS will check the SD3E Closed directory to determine if no further files for a product are expected for a given day:

/NPPSD3/ftp/pub/Closed/VIIRS
/RDR
/YYYYMMDD...
/Land
/YYYYMMDD...

When ftp-pulling a data product or algorithms from SD3E, NPPDAPS will download associated an text file in the same place that contains file name, file size and checksum information to verify the integrity of the data product or algorithm.

2.4.2.1.2 Land PEATE-CLASS Interface

A new interface to CLASS to submit ad-hoc data requests for xDRs and IPs if the requested data will be no longer available in SD3E, and to ingest the subscribed data delivered by CLASS.

In order to submit orders to CLASS, Land PEATE must become a subscriber to the ADS/CLASS web interface at http://www.class.nova.gov, then manually enter in the product requests (either subscription or ad-hoc request), and also manually handle all status and error messages from the CLASS web interface.

NPPDAPS will provide a FTP directory location for CLASS to push the subscribed xDRs, selected IPs, calibration products, operational algorithms, official ancillary data, and the corresponding Delivery Notice. The integrity of the files will be checked by using the digital signatures included in the Delivery Notice from CLASS as they are ingested by the IMPORT subsystem.

2.4.2.1.3 Land PEATE-I&TSE Interface

A new interface to I&TSE to submit data requests to and ingest xDRs and IPs data from the I&TSE, and deliver enhanced VIIRS Land algorithms and test xDRs from Land PEATE to the I&TSE.

The Interface will be implemented with the Application Programming Interfaces (APIs) specified in "NPOESS to NPP SDS Interface Control Document" for data product submission and for retrieving data delivery status messages from the mini-IDPS.

Both Land PEATE and mini-IDPS will use FTP to push the requested products, algorithms, and Delivery Reports to each other in pre-specified FTP directory locations. The integrity of the subscribed files will be checked by using a checksum if provided in the Delivery Report.

2.4.2.1.4 Land PEATE-CasaNOSA Interface

A new interface to CasaNOSA will be implemented to submit requests for pre-launch algorithms and source codes and test data sets, and to retrieve the requested data from CasaNOSA. The Land PEATE will also use the interface to submit the updated and enhanced algorithms and source codes to CasaNOSA.

Land PEATE members will become subscribers to the CasaNOSA system, and will then manually enter in the product requests and download pre-launch algorithm and data via the CasaNOSA web interface at http://casanosa.nova.gov. The same web interface will be used to upload enhanced algorithms and test data to the CasaNOSA. Access will be gained to the CasaNOSA website by sending email to noda.dev@noaa.gov to acquire a user name and password.

Several ways will be used to obtain data from CasaNOSA. Through the website, a single file download will be made by clicking the filename link and saving the file to a local machine, or by selecting multiple files and then making a gzipped tar file and downloading it via HTTPS. Land PEATE plans to retrieve algorithms and data by using CasaNOSA's Client Side Application/Download Manager that has features of MD5 checks and data synchronization.

2.4.2.1.5 Land PEATE-NICSE Interface

A new interface to NICSE will be implemented to receive regular or ad-hoc requests for Land PEATE products, and to stage the data for pull or push to NICSE. The Land PEATE will also receive process requests from NICSE to generate specific test granules.

NICSE can either submit subscription order to receive data on a regular basis or submit ad-hoc data request by email for specific test granules. NICSE can also order any data from the Land PEATE web interfaces (see more details in Section 2.2.2.1.3).

2.4.2.1.6 Land PEATE-ST Interfaces

Land PEATE will provide xDRs/DDRs data and data analysis tools to the ST members for xDRs evaluation and algorithms enhancement. Land PEATE plans to use LAADS (see Section 2.2.4.2) to archive all Land VIIRS xDRs and test data generated in NPPDAPS so the ST members can search and order data in LAADS for analyzing and evaluating Land xDRs and algorithms.

2.4.2.2 Land PEATE CM System

MODAPS uses a CM system based on ClearCase, but NPPDAPS will have a new CM system based on SVN. A set of new scripts and tools will be developed for the NPPDAPS CM system that maintains the software configuration controls for the operational (pre- and post-launch) and science algorithms/source codes. See Section 2.2.3.1 for more details of Land PEATE CM system.

A set of new scripts will need to be developed that will act as a wrapper around the CM system. There will be a wrapper script that takes care of protecting sensitive software. When a developer checks-out of the CM system a sensitive file, the wrapper sets the proper Unix group for the file and makes it accessible only to the owner and to the group (not to the world). The wrapper will also set the user’s “umask” and the directory’s SGID, which causes any new files created in the same directory to inherit the restrictive file access permissions.

There will also be scripts that will be executed by the repository code when certain actions take place. These scripts will be useful for notification, authorization, or whatever purposes the repository administrator desires.

2.4.2.3 LAADS

The Land and Atmosphere Archive and Distribution System (LAADS) will provide the ST with the capability to search and order VIIRS data products and view reports on NPPDAPS processing. No modifications to LAADS will be required other than possible changes needed to support products in HDF 5 format.

2.4.2.4 NPPDAPS Ingest

MODAPS ingest system will be modified to handle specific metadata and filename conventions of NPP VIIRS xDRs and ancillary data, which have not been completely determined.

2.4.2.5 NPPDAPS PGE/Loader

MODAPS PGE and Loader subsystems will be modified and optimized to handle VIIRS Land PGEs production rules and special process requirements. For example, in order to run NPP operation code in NPPDAPS, operation code wrappers (see 2.2.2.4.6) must be developed and integrated into NPP PGEs.

2.4.2.6 NPPDAPS Sybase Database Models

MODAPS Sybase database models will be modified to meet NPP Land PEATE algorithm process and data archive requirements in NPPDAPS and LAADS.

2.4.2.7 Security

No additional work is required in the area of IT Security.

2.4.2.8 xDR Evaluation and QA Tools

LDOPE will modify the QA tools, processes and applications currently being used in the QA of MODLAND products to meet the NPP VIIRS Land xDR format. New evaluation and QA tools will be identified and developed. New scripts and source codes to create browses, time series analysis system and animation will be developed. Current metadata database will be reviewed and redesigned to identify the required fields in the context of NPP VIIRS Land xDRs format.

2.5 Deployment Plan

2.5.1 Software Build Plan

The Land PEATE will be deployed in a series of 3 builds which will add increasing functionality to the instance of MODAPS that serves as its foundation.

Build 1 was delivered in March 2006 and met the basic set of requirements shown below (requirement numbers from Ref [2] are in parenthesis):

- Ingest products from the SD3E (3.4.1.1-3.4.1.5)
- Ingest pre-launch algorithms, calibration, test data files and instrument parameters from CasaNOSA (3.4.1.14)
- Store/Catalog data (3.4.2.1)
- Manage software configuration (3.4.3.1)
- Ingest operational algorithms from the SD3E (3.4.4.1)
- Ingest management direction from PSOE (3.4.4.2)
- Receive Calibration LUTs from NICSE (3.4.4.4)
- Receive algorithm status from I&TSE (3.4.4.5)
- Have capability to assess xDR and IP science algorithms and proposed improvements (3.4.4.6-3.4.4.9 and 3.4.4.15). Will demonstrate for a limited set of VIIRS algorithms that begin with SDRs as input and produce vegetation indices.
- Provide status report to PSOE (3.4.4.21)
- PEATEs can provide the ST with access to NPP science data archived at the PEATEs and can compress data delivered to users (3.4.5.1 and 3.4.5.5)

Build 2 will be ready for testing in November 2006 and meeting the following additional requirements:

- Obtain products from CLASS (3.4.1.6-3.4.1.12)
- Obtain ancillary data products from other sources (3.4.1.13)
- Ingest engineering reports from C3S (3.4.1.15)
- Capability to request and receive instrument service requests from PSOE (3.4.4.3 and 3.4.4.22)
- Develop comparison tools and compare products against data from other satellites and against products produced with standard and alternative algorithms and assist the ST in developing alternative algorithms (3.4.4.10-3.4.4.13)
- Generate SDR and EDRs with alternate LUTs and Test data products (3.4.4.14-3.4.4.16)
- Develop improvements for SDR and EDRs and test and evaluate these improvements (3.4.4.17-3.4.4.19)
- Capability to support ST in documenting software (3.4.4.20)
- Execute processing requests by NICSE staff to support calibration validation (3.4.4.23)
- Provide NICSE with results of calibration evaluation (3.4.4.24)
- Shall provide capabilities necessary to validate EDRs (3.4.7.2)

Build 3 will be delivered in November 2007 and consist of the final launch-ready version of the Land PEATE. Included in this build will be updates in the following areas:

- quality assessment tools from the LDOPE team
- validation tools for the ST including software to generate comparisons between EDRs and products from other sensors
- launch-ready version of IDPS operational code integrated into evaluation processing system
- software that will generate “improved products” (if provided by the ST) for comparison with EDRs

The requirement to assess short and long-term quality of the EDRs (3.4.7.1) will be undertaken after launch and will continue over the operational life of the Land PEATE’s Land quality assessment team (LDOPE). The capability of the LDOPE to support the quality assessment of products will be demonstrated in Build 2.

2.5.2 Hardware Deployment Plan

The currently installed Land PEATE hardware includes initial elements of the Science Analysis Facility and the Engineering Support System described earlier. Specific systems and their configurations are:

- npp1 used to run ST analyses, dual processor (Intel Xeon-based) Dell 2850 server with a 4.5TB SATA-2 RAID storage unit
- nppcm runs subversion configuration management system, dual processor (Intel Pentium based) SGI 1100 server
- MTVS3 used in integration and testing of NPP SCI and OPS software, 28 processor SGI Origin 350
- minion 5046 dual processor (Intel Xeon-based) Dell 2850 for running processing jobs

Two 75KVA Power Distribution Units were installed in S-009 in March 2006 followed by computer systems to support the testing and integration of early builds of NPPDAPS and pre-launch evaluation of IDPS operational software:

- npptest - used to test new instances of NPPDAPS software builds without impacting the integration and test system, dual processor (Intel Xeon-based) Dell 2850 server
- nstor1-nstor2 - prototype archive nodes used to hold VIIRS test data sets, dual processor (Intel Xeon-based) Dell 2850 server with two 4.5TB SATA-2 RAID storage units attached.
- minion 5047 – minion 5054 used to test production of NPP products, Dell 2850 servers
- nppqa1-nppqa2 - quality assurance systems used to perform quality assurance and distribute the results, Dell 2850 servers.

By the end of February 2008, we will have installed the following additional hardware to reach the launch-ready configuration of the Evaluation Processing System illustrated earlier in Figure 2-2.1:

- 40 compute servers (minions 5046 – minions 5054) to generate VIIRS products, Dell dual-processor servers
  6 archive nodes (nstor3-nstor8) to hold VIIRS products, dual-processor servers with 360TB attached storage

3. Appendix

3.1 Requirements Traceability Matrix

SDS Rqmt. #	SDS Requirement Title	Subsystem	Bld 1	Bld 2	Bld 3
3.4.1.1	PEATE xDR Ingest from SD3E	**Import**		X	X
3.4.1.2	PEATE Intermediate Product Ingest from the SD3E			X	X
3.4.1.3	PEATE Official Ancillary Data Ingest from the SD3E			X	X
3.4.1.4	PEATE Calibration Product Ingest from the SD3E			X	X
3.4.1.5	PEATE Request Listings			X	X
3.4.1.6	PEATE Product subscription to ADS	**Import**		X	X
3.4.1.7	PEATE Ad-hoc requests from ADS			X	X
3.4.1.8	PEATE xDR Ingest from ADS			X	X
3.4.1.9	PEATE Official Ancillary Data from ADS			X	X
3.4.1.10	PEATE Calibration Product Ingest from ADS			X	X
3.4.1.11	PEATE IP Product Ingest from ADS			X	X
3.4.1.12	PEATE ADS query and Request Status Ingest			X	X
3.4.1.13	PEATE Alternate Ancillary Data Ingest			P	X
3.4.1.14	PEATE Pre-launch Data Ingest	**Import**	X	X	X
3.4.1.15	PEATE Engineering Service Ingest	**Subversion**		X	X
3.4.2.1	Store/Catalog all data needed for EDR evaluation	**Metadata Archiver**	P	P	X
3.4.3.1	Manage Software Configuration	**Subversion**	P	X	X
3.4.4.1	Operational Algorithms Ingest from SD3E	**Import**	P	P	X
3.4.4.2	PEATEs Management Direction Ingest	Operations		X	X
3.4.4.3	PEATEs Instrument Service Report Ingest	Operations		P	X

Requirements Traceability Matrix (continued)

SDS Rqmt. #	SDS Requirement Title	Subsystem	Bld 1	Bld 2	Bld 3
3.4.4.4 3.4.4.5	PEATE NICSE Cal LUT Ingest PEATE I&TSE Algorithm Status	ASI		P X	X X
3.4.4.6 3.4.4.7 3.4.4.8	Pre-Launch Assessment xDR Implementation Assessment EDR Algorithms	**PGE, Metadata,** ASI, LDOPE	P P	P P P	X X X
3.4.4.9	SDR and EDR Testing Environment	**PGE,** Operations		P	X
3.4.4.10 3.4.4.11 3.4.4.12	Comparison Tools Development Comparing Against Other Data Comparing Against Other Products	LDOPE		P P P	X X X
3.4.4.13	Analyzing Algorithm Improvement/Enhancement	**PGE,** LDOPE, Operations, ASI		P	X
3.4.4.14 3.4.4.15	Generating SDR Generating EDR	**PGE, Loader,** ASI		P	X
3.4.4.16	Test Data	**PGE,** ASI		X	X
3.4.4.17 3.4.4.18	Developing SDR algorithm improvements Developing EDR algorithm improvements	**PGE,** ASI,		P P	X X
3.4.4.19	Testing Algorithm	Operations, LDOPE		P	X
3.4.4.20	Documentation	ASI	P	P	X
3.4.4.21	PEATEs Management Report	Management	X	X	X
3.4.4.22	PEATEs Instrument Service Request	Operations		X	X
3.4.4.23	PEATE Quality Control Response	**PGE**, AIS, Operations		X	X

Requirements Traceability Matrix (continued)

SDS Rqmt. #	SDS Requirement Title	**Subsystem**	Bld 1	Bld 2	Bld 3
3.4.4.24 3.4.5.1	PEATE Result of Cal Evaluation PEATE Science Data Export	**Export, LAADS**	 P	X P	X X
3.4.5.2	PEATE Data Compression	**PGE, LAADS**	P	P	X
3.4.7.1	Land Product Assessment	LDOPE	P	P	X
3.4.7.2	Land EDR Evaluation	**PGE, LAADS** Operations		P	X
3.6.5	Science Team Interface	**LAADS,** LDOPE, ASI	P	X	X
3.7.1	Land PEATE ready at-launch	**All**			X
3.7.2	Pre-launch Interface testing support	**All**		P	X
3.7.3	Operational Availability of .95	**All**		P	X
3.7.4	System Failure	**All**	X	X	X
3.7.5	Operational duty cycle of 7x24	Operations			X
3.7.6	Design Life of L+5	**All**	P	P	X
3.7.7	Maintainability	**All**	X	X	X
3.7.8.1 3.7.8.2 3.7.8.3	Security – unclassified facility Security – Comply with minimum SER baseline Security – Operator/Analyst privileges	**N/A** **All** **All**	X X X	X X X	X X X
3.7.8.4	SDS Data Verification	**Import**		P	X
3.7.9	Data Integrity	**All**	P	X	X

3.2 Applications

This section lists applications and software that will form part of the Land PEATE implementation but will not be developed locally.

The Commercial Off-the-Shelf (COTS) applications including the following:

- Sybase ASE
- Sybase PowerDesigner
- Sybase JConnect for JDBC
- The Portland Group Fortran (77 and 90) Compilers
- NcFTP (Client)
- IDL/ENVI
- Microsoft Office
- Microsoft Window XP
- Microsoft IE
- Adobe Acrobat

The Open Source Software applications including the following:

- Mandrake Linux
- CentOS Linux
- GNU C compiler
- GNU make
- Bugzilla
- Subversion
- Apache web server
- tHttpd web server
- Perl
- Sybperl
- Mason
- Sun's Java, JavaWebStart
- vsftpd
- xinetd
- GD graphics
- ImageMagic
- GIMP
- HDF4 and HDF5
- HDP
- HDFLook
- MRT and MRTSwath
- HEG
- HEWBE
- hrepack and hrepack5
- procmail
- Mozilla
- OpenOffice
- Cygwin

3.3 Assumptions

The following assumptions have been made for the purposes of generating this document:

1. Aggregation of products – We expect that the VIIRS SDRs delivered by the ADS to be aggregated to match our needs. If the products are not aggregated as we requested, then we will need to write software to perform the aggregation.

2. Product computational loads – We expect the computational (CPU) resources to be similar to those needed by MODIS. Larger computational loads will cause the overall throughput (X) rates to be smaller.

3. Product volumes – We expect the product volume (including DDRs) to be similar to MODIS L1 and Land products.

4. SDR and EDR Product format – We expect the SDR and EDR product format to be self-descriptive similar to the EOS/MODIS products. This includes having array scales and offsets and appropriate global metadata.

5. Science code kept up to date – We assume that the SCI code will be updated to reflect any changes that are made in the OPS code until a single baseline is established.

6. Proxy data – We assume that the majority of the proxy data will be provided by the IPO/NGST in a timely manner.

7. Proxy data generator – We assume that the IPO/NGST will provide the geolocation software needed to generate the proxy data.

8. Diagnostic Data Records – We assume that the DDRs will be made using straight forward modifications to the corresponding MODIS software.

9. Number of algorithm changes/updates – We assume that the number of changes and updates to the algorithms will be similar to what occurred for MODIS.

10. New production rules – We assume that it will be possible to implement any new VIIRS specific production rules in the system. Of particular concern are rules involved in producing continuously updated gridded products.

11. Algorithm software availability – We expect that new versions the SCI and OPS code (with corresponding LUTs and documentation) will be available in a timely manner though CasaNOSA.

12. IP product availability and delivery – We assume that examples of all Granulated IPs will be available to allow our implementation to be verified. We assume that snapshots of all Gridded IPs will be available at least every 16 days.

13. IP product format – We assume that the IPs will have a product format similar to EDRs.

14. NPP products --.We assume that all NPP products, xDRs, IPs, ancillary data, DDRs have archive and searchable metadata (such as Start/EndTime, geolocation metadata, Day/Night flags etc.) so the data can be ingested and archived in NPPDAPS and LAADS.

15. Linux processing systems – Our Linux processing systems have dual processors with 2GB of memory. We assume that at least 2 and ideally 4 streams of product generation software can run for the xDRs and IPs in a 2GB memory space in order to take advantage of dual processors as we do with MODIS production software.

List of issues/concerns:

1. ADS I/F – We need to have a machine-to-machine ordering and delivery interface without email. The machine-to-machine ordering mechanism should be similar to the current EOS/DAAC interface. The delivery approach should be similar to EOS/SIPS with a data-delivery record/file pushed to the ftp directory.

2. ICDs --.The ICDs between PEATEs and data providers (like ADS, IDPS, etc) are not all available or not known to us.

3.4 Acronyms

AADS	Atmospheres Archive and Distribution System
ADP	Ancillary Data Provider
ADS	Archive and Distribution System
API	Application Programming Interface
ASI	Algorithm Software Integrator
C3S	Command, Control, and Communications Segment
Cal	Calibration
CARS	Climate Analysis and Research Service
CasaNOSA	“Home” of NOSA
CI	Configuration Item
CLASS	Comprehensive Large Array-data Stewardship System
CM	Configuration Management
CRBDR	Coarse Resolution Browse Data Record
CVS	Concurrent Versioning System
DAAC	Distributed Active Archive Center
DDR	Diagnostic Data Record
DMS	Data Management System
EDR	Environmental Data Record
EDT	Eastern Daylight Time
ESDT	Earth Science Data Type
FTP	File Transfer Protocol
GDAAC	Goddard Earth Sciences DAAC
GNU	“GNU’s not UNIX”
GTSDR	Golden Tile Statistics Data Record
HDF	Hierarchical Data Format
HDP	HDF-EOS Dump tool
HEG	HDF EOS GEOTIFF conversion tool
HEWBE	HDF EOS Web-Based subsetter Back-End
I&TSE	Integration and Test System Element

I&T	Integration and Test
ID	Identification
IDL	Interactive Data Language
IDPS	Interface Data Processing Segment
IP	Intermediate Product
IPO	Input-Processing-Output
ITAR	International Traffic in Arms Regulations
LAADS	Land and Atmosphere Archive and Distribution System
LDOPE	Land Data Operational Product Evaluation
LTER	Long Term Ecological Record
LUT	Lookup Table
MODAPS	MODIS Adaptive Processing System
MODIS	Moderate-resolution Imaging Spectroradiometer
MRT	MODIS Reprojection Tool
NCEP	National Centers for Environmental Prediction
NDVI	Normalized Difference Vegetation Index
NESDIS	National Environmental Satellite, Data, and Information Service
NEXT	NPP Data Exchange Toolkit
NICSE	NPP Instrument Calibration and Support Element
NGST	Northrop Grumman Space Technology
NOSA	NOAA Observing System Architecture
NPOESS	National Polar-Orbiting Operational Environmental Satellite System
NPP	NPOESS Preparatory Project
NPPDAPS	NPP Data Analysis and Processing System
OBC	On Board Calibration
OMI	Ozone Monitoring Instrument
OMPS	Ozone Mapping and Profiler Suite
OPS	IDPS Operational Algorithms
PCF	Process Control File
PEATE	Product Evaluation and Analysis Tool Element
PGE	Product Generation Executive
POD	Processing on Demand
PSOE	Project Science Office Element
PST	Project Science Team
QA	Quality Assurance
QALDR	QA Logs Data Record
RDR	Raw Data Record
SD3E	SDS Data Delivery Depository Element
SDR	Sensor Data Record
SDS	Science Data Segment
ST	Land VIIRS Science Team
SVN	Subversion Version Control Tool

TM	Test Manager
TP	Test Plan
TT	Test Technician
Val	Validation
VIIRS	Visible Infrared Imager Radiometer Suite
xIP	Intermediate Products generated within the PEATE
xDR	Any of RDR, SDR, and/or EDR
XML	Extended Markup Language